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LALA

Building Capacity to Use Learning Analytics to Improve Higher Education in Latin America

(586120-EPP-1-2017-1-ES-EPPKA2-CBHE-JP)

LALA Handbook

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Content

Chapter 1: Short version of the LALA handbook

The LALA Project (Building Capacity to Use Learning Analytics to Improve Higher Education in Latin America) is an Erasmus+ project funded by the European Commission that aims to develop local capacities in Latin American Higher Education Institutions (HEI) to create, adapt, implement and adopt Learning Analytics (LA) tools and consequently improve academic decision-making processes.

Learning analytics (LA) can be defined according to the 1st conference of Learning Analytics [1] as "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs". Therefore, learning analytics make use of educational data to try to improve the learning process.

There are regions in the world where the use of learning analytics is underrepresented. This is the case of Latin American. All the potential of educational data is not often used in Higher Education institutions (HEIs) in Latin American although known issues are a need such as the reduction of dropout. Moreover, top conferences such as Learning Analytics & Knowledge has a low level of Latin American representatives. The LALA project (https://www.lalaproject.org/) started in October 2017 with the aim of increasing the use of learning analytics in Latin America. The LALA project consortium is formed by Universidad Carlos III de Madrid (UC3M), Katholieke Universiteit Leuven (KUL), University of Edinburgh (UED), Pontificia Universidad Católica de Chile (PUC), Universidad Austral de Chile (UACH), Universidad de Cuenca (UCUENCA), and Escuela Politécnica Superior del Litoral (ESPOL). Other associate institutions of Latin American joined it during the project.

During the LALA Project, a lot of work has been done towards the adoption of LA solutions for Latin American HEIs. This document is a summary of the lessons learned organized as a guideline for supporting institutions in the adoption of LA solutions, adapting the LA tools developed, and the results of the pilots studies conducted in Latin American HEIs during the LALA project. The results obtained could be use both, as an example of application, or as an starting point for addressing the implementation of LA solutions for those institutions with similar characteristics.

This chapter provides a general overview of the LALA Project. This is a joint effort among all the partners of the LALA project and the LALA community. Our goal is to demonstrate a starting point for the adoption of LA and some specific tools. In many cases, readers will need additional information, which can be found in the following chapters of the LALA handbook: the LALA framework, the LALA adoption and adaptation of tools and the LALA pilot experiences chapters. Some of the results have been published and details can be seen in different publications in journals and conferences, the main ones can be found on the section "Main related publications with the LALA Project".

1.1 LALA Framework

The LALA framework has been proposed to guide HEIs in the design, implementation and use of LA tools considering four different dimensions. Each dimension includes a set of artifacts and activities to support this process from different perspectives.

1) **Institutional dimension**. The main objective is to identify to understand what the current state and the desired state of the institution are in relation to policies and strategies for the incorporation of LA tools in the institution. Each institution might have different goals, objectives, strategies, tools, services, expectations policies regarding LA. The main stakeholders should be

taken into account so that we can know the current state of LA in their institutions and their desires and points of view so that LA solutions can be adapted to suit each institution depending on their needs, culture, etc.

a. **Artifacts**. We provide different artifacts adapted from the SHEILA European Project [2] to the Latin American context so that these needs, current state and expected future evolution can be retrieved. To achieve it, an institution can use the following artifacts adopted in the LALA project to explore this dimension:

   - **LALA Canvas**. It is a template used to guide a group discussion to collect qualitative information from the different stakeholders of the institution about its current state in terms of LA and its expectations (see figure 1-1). The template is based on the six dimensions of the ROMA framework [3].
   - **Focus group guidelines and questionnaires for teachers**. Questionnaires and focus group guidelines for teachers to extract information about the institutional political context, institutional needs, and expectations about the use of educational data.
   - **Focus group guidelines and questionnaires for students**. Questionnaires and focus group guidelines for students to extract information about the institutional political context, institutional needs, and expectations about the use of educational data.
   - **Interview protocol for managers and other key decision makers**. Guidelines for interviewing managers and decision makers and extract information about the institutional political context, institutional needs, and expectations about the use of educational data.

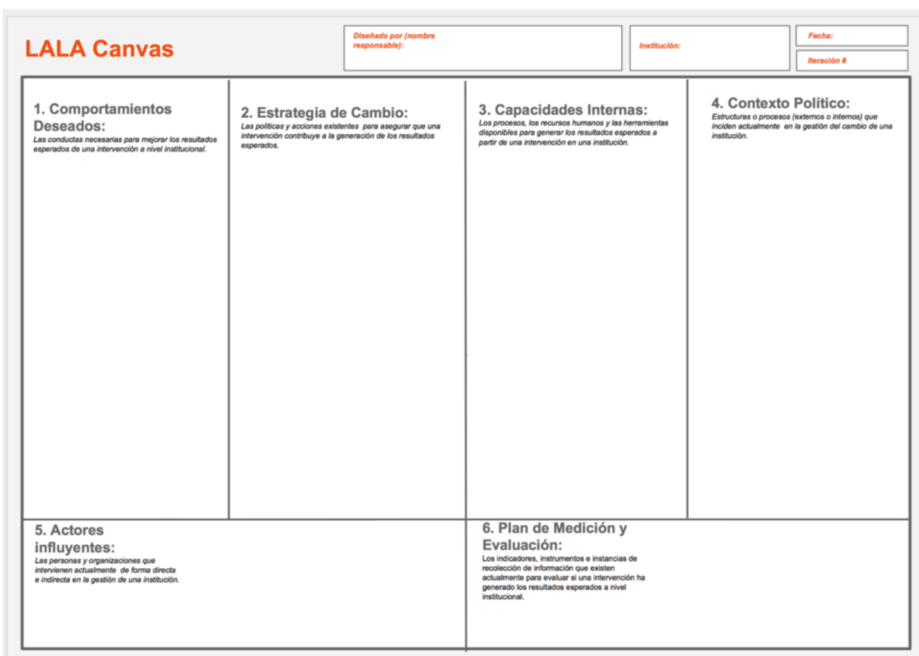


Fig. 1-1. Screenshot about the LALA Canvas

b. **Needs of LA in Latin American Institutions (PUC, UACh, ESPOL and U. Cuenca)**. All artifacts and instruments of the Institutional Dimension were examined in the four Latin American partner Institutions of the project. After applying the LALA FW, a summary of the results we obtained are the following:
   - Students need quality feedback and data-driven support from teaching staff to improve their learning results.
   - Students need timely support interventions from staff and managers when they are facing difficulties that affect their academic performance.
   - Teaching staff need timely alerts from managers to provide better support to students who are facing difficulties that affect their academic performance.
   - Teaching staff needs meaningful and "easy-to-use" feedback about their performance and the quality of their teaching to inform their practice.
   - Managers need quality information from staff to evaluate support interventions targeted to students.

2) **Technological dimension**. The main objective is to provide of guidelines for the design, adoption, adaptation and implementation of LA tools and services in HEIs. Developers are also added as stakeholders for this dimension.
   a. **Artifacts**. We provide different artifacts so that LA technical solutions can be envisioned.
      - **Forms for managers, researchers, developers and academic staff.** These forms are adapted from the ORLA framework [4] and should be used to define the requirements of the LA software tools. The forms guide different stakeholders for the specific definition and design of the LA tools.
      - **Guideline of the technical considerations for the development and implementation/adaptation of LA tools.** A guideline organized as a set of 25 questions to be answered collaboratively including at least one representative from each of the following stakeholders: teaching staff, managers, researchers in LA, and tool developers. The results of this questionnaire will guide the definition of the main requirements for the LA tools, considering all stakeholders' perspectives.
      - **Guidelines for the design and evaluation of LA tools**. A set of guidelines that lists the set of aspects that need to be considered for the evaluation of the LA tools, as well as the ethical considerations to be taken into account.

   b. **Application in four Latin American partners**. Each Latin American partner has applied the artifacts proposed in the technological dimension for the design and implementation of the LA tools. Depending on the needs on each partner institution, some phases (or parts of a phase) were not considered necessary or were adjusted. It is worth noting that these phases typically occur in an iterative way. For example, in our experience, there tended to be different meetings with different stakeholders in different moments. In each moment, stakeholders were provided with the current design of the tool, e.g. with screenshots of the design so that they could provide more specific feedback about the LA tools and services.

3) **Ethical dimension**. The main objective is to provide a set of guidelines for helping HEIs to set up an ethical framework within their institutions to address LA ethical issues.
    a. **Artifacts.** Relevant literature, guidelines for identifying LA ethical needs and ethical templates. A list of relevant documents and papers addressing ethical LA related issues were identified and listed. In addition, we provided a set of guidelines and questionnaires adapted from the SHEILA project (same instruments used to explore the institutional dimension) to identify the ethical considerations of the different stakeholders. Moreover, example templates for data-related consent forms were also provided.
        - **Selection of relevant documents from the state of the art about privacy and ethical issues in LA.**
        - **Focus group protocols and questionnaires for teachers**. A set of questionnaires and guidelines for focus groups to understand the ethical needs, and expectations about the use of educational data for the institution from the perspective of teachers.
        - **Focus group protocols and questionnaires for students**. A set of questionnaires and guidelines for focus groups to understand the ethical needs, and expectations about the use of educational data for the institution from the perspective of students.
        - **Interview protocols**. Guidelines for conducting interviews with managers and decision makers to understand their perspective regarding the ethical needs, and expectations about the use of educational data for the institution.
        - **Ethical templates**. We provide a set of forms and documents (e.g., consent forms) so that other HEIs might have them as examples to be adapted to their institution and needs.
    b. **Application in four Latin American partners**. Each Latin American partner has applied this ethical dimension. Different ethical needs and perceptions emerged during the analysis.

4) **Communal dimension**. The main objective is to build a community of people interested in LA in Latin America so that they can share knowledge, experiences, mature the development of LA in Latin America, and connecting the local community with the global one. This dimension is in charge of organizing activities for disseminating the benefits of LA and fostering its development in the region.
    a. **LALA community and LALA SOLAR SIG**. The LALA community is formed by individual people and institutions in Latin America. There is a distribution list to share information, a twitter and Facebook account as well as specific meetings and activities. The natural continuation of the community is the LALA SOLAR special interest group.

b. **LALA conference and LASI-LA**. Once a year, there is a LALA conference and a Learning Analytics Summer School Local in Latin America in which researchers get together for knowledge exchange and building through paper presentation, keynotes, or workshops.

Institutions may choose to engage with all or some of the four dimensions of the LALA framework in any order depending on the institutional needs and culture, but they could also be applied in an integrative manner. In this second case, each of the four dimensions of the LALA framework can be applied in four phases iteratively: diagnostic, design/prototyping, piloting, scaling up (see figure 1-2).

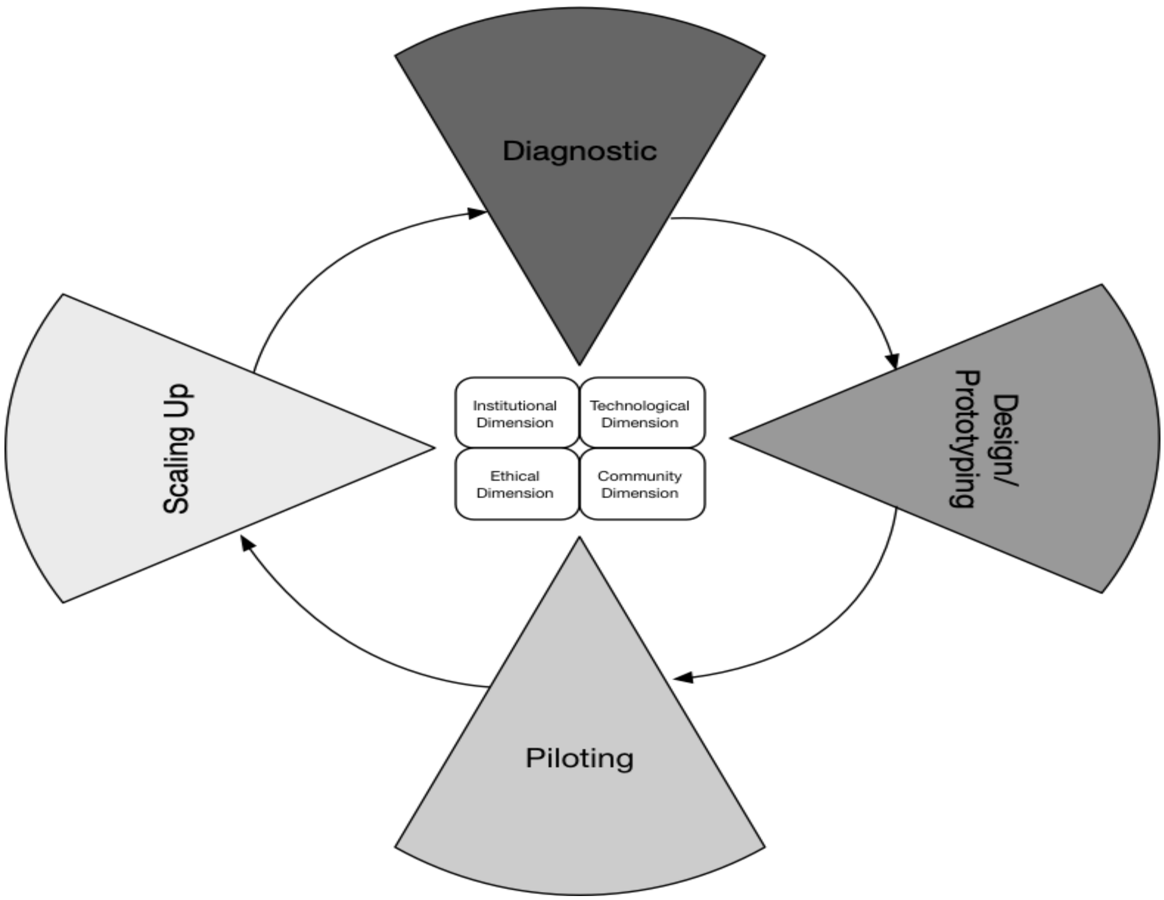


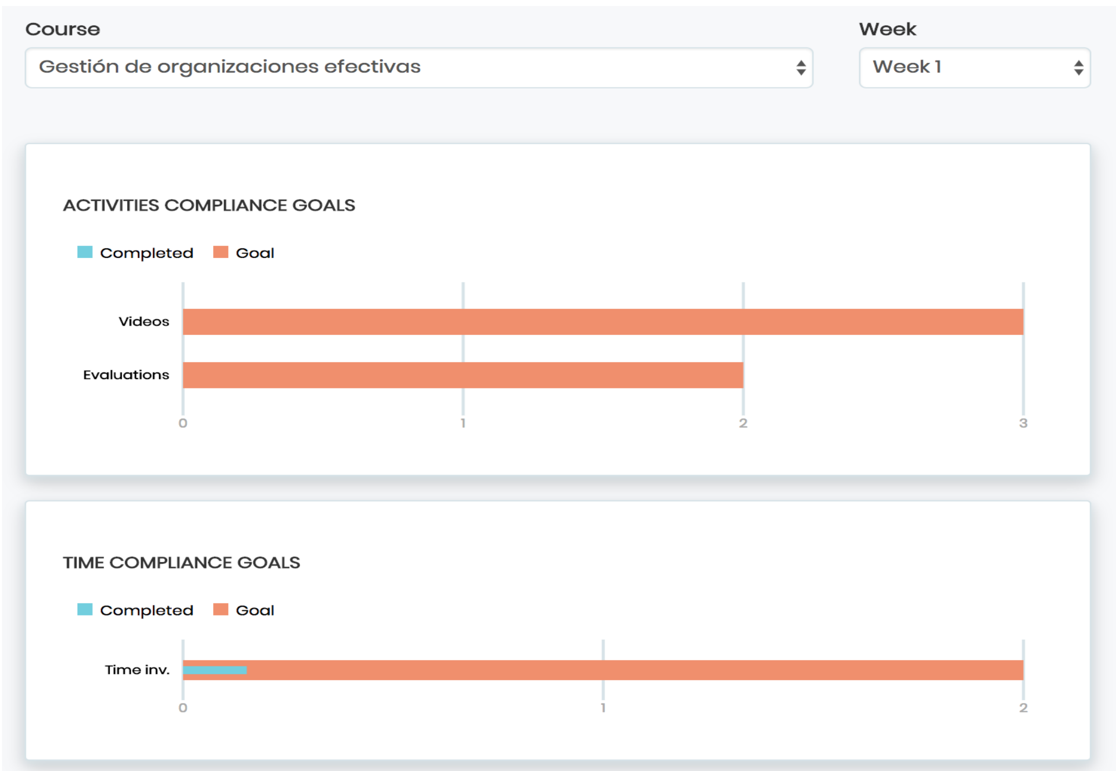
Fig. 1-2. Four phases of application of the LALA framework

1.2 LALA Adaptation and Adoption of Tools

There are four main different LA tools that have been adapted or adopted in Latin American institutions in the LALA Project. We mean adaptation when the new tool is inspired from a source LA tool but there are differences, and we mean adoption when the source LA tool is configured and personalized but it is not a new tool. These tools have been adapted, adopted or inspired by tools developed in Europe, i.e., a counselling tool at Katholike Universite of Leuven, a dropout prediction tool at Universidad Carlos III de

Madrid, and the OnTask tool [5] in which University of Edinburgh has been involved in the development process.

1) **NMP, a Counselling tool for online and blended learning courses**. NoteMyProgress (NMP) is a tool to monitor student progress in an online course. It was originally developed for the Coursera MOOC platform but has also been adapted for Moodle. NMP proposes a set of dashboards based on students' activity in the course so as to help self-regulate their own learning. There are different metrics about the student progress and comparisons, e.g. the expected compliance goals and the real goals achieved by the students. Two screenshots are provied bellow as examples in Figure 1-3.



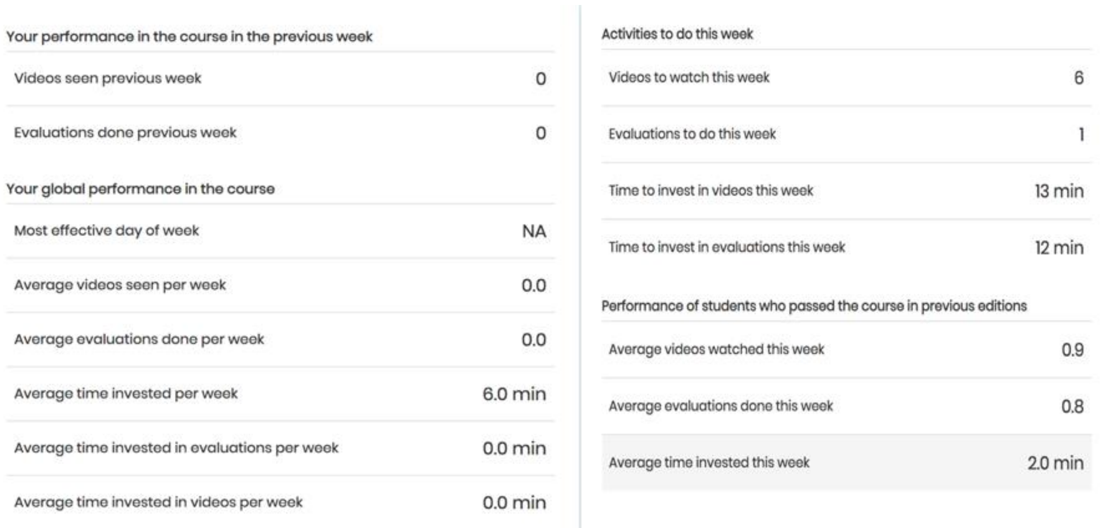
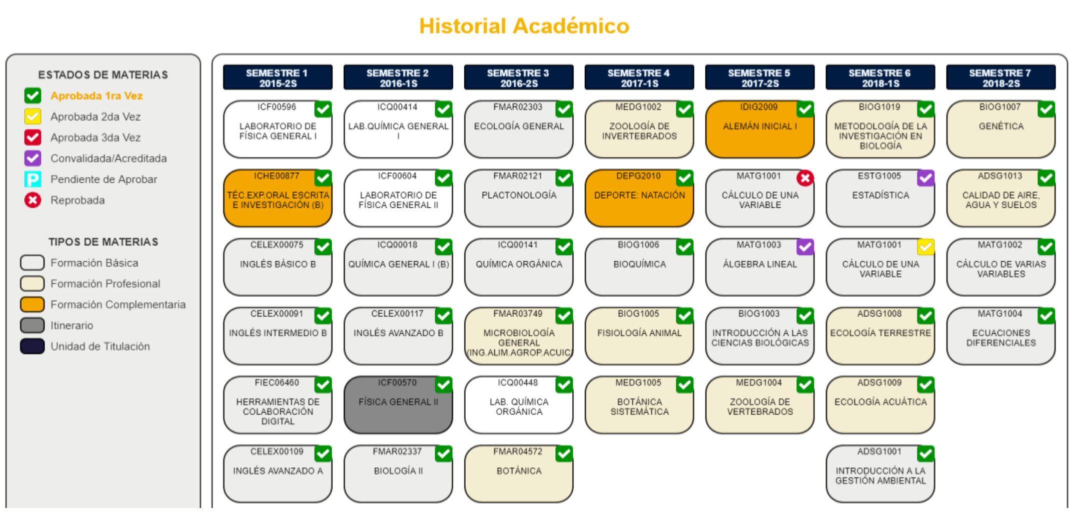


Fig. 1-3. Screenshots examples of NMP

2) **Counselling for degrees.** This tool allows a global overview of each student academic performance in different courses of a degree. Counsellors can see the academic history of each student including the degree in which a student is registered, the courses in which the student is registered for each semester, the number of times a student needs to pass each subject, the grades of students in each course, comparison with other students, general statistics, simulation of workload depending on the new courses students can take, etc. Two screenshots are provided bellow as examples in Figure 1-4.



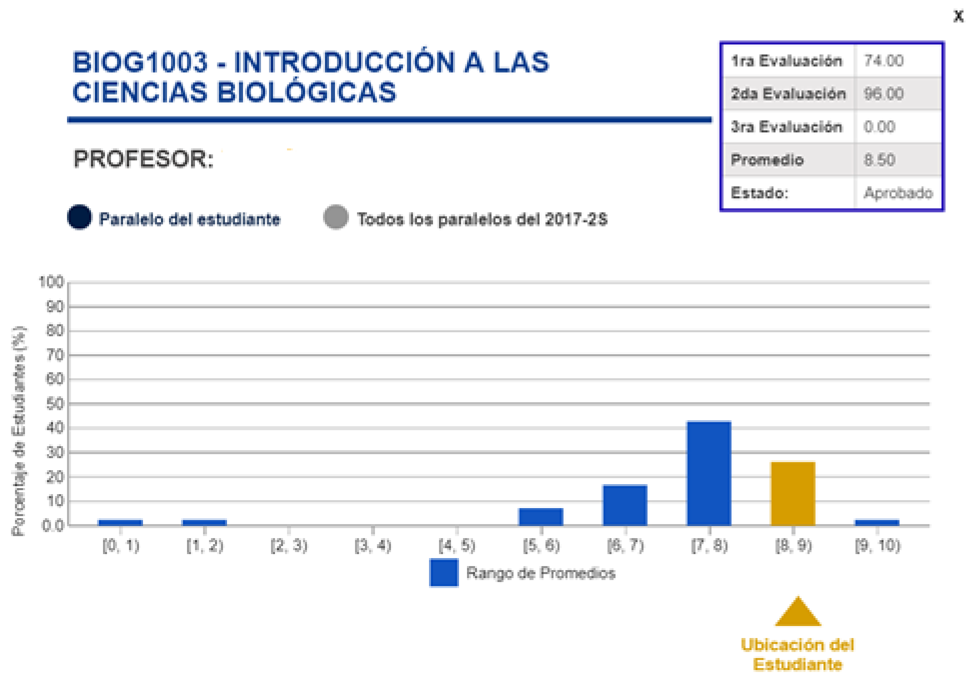


Fig. 1-4. Screenshots examples of counselling for degrees tool

3) **Dropout for courses**. This tool provides probabilities of student dropouts in a specific course. This tool was proposed to support teachers of massive online learning courses in sending more personalized e-mails to students. This tool uses dashboards showing the probability that a student drops a course at an early stage, thus being able to make interventions. A screenshot of the tool is provided below in Figure 1-5.

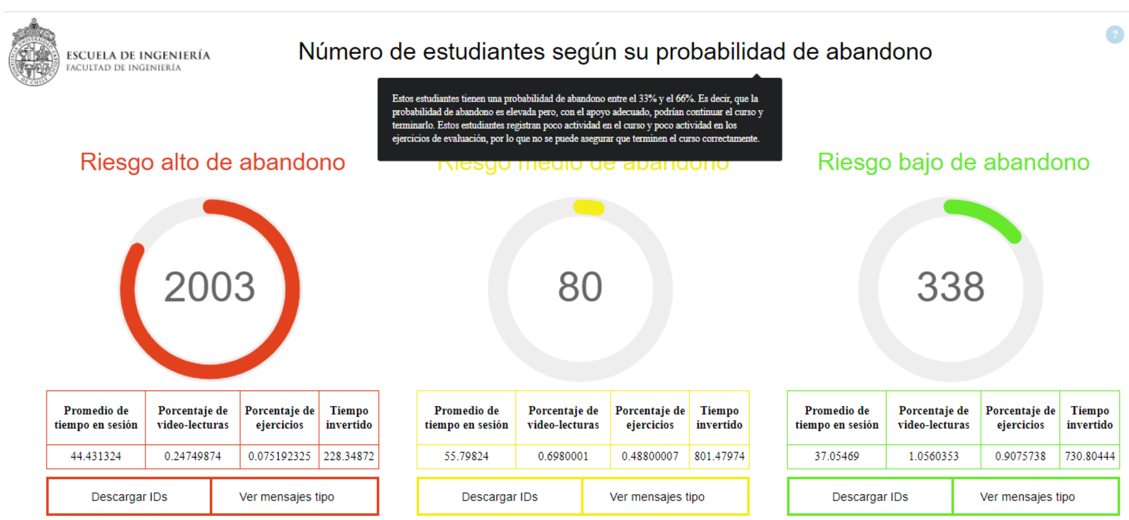


Fig. 1-5. Screenshots examples of the dropout tool for courses

4) **Dropout for degrees**. This tool provides the probability that a student drop out of a degree at an early stage, thus prompting timely interventions. There is also information about related variables that can make an influence on this probability. A screenshot of the tool is included below in Figure 1-6.

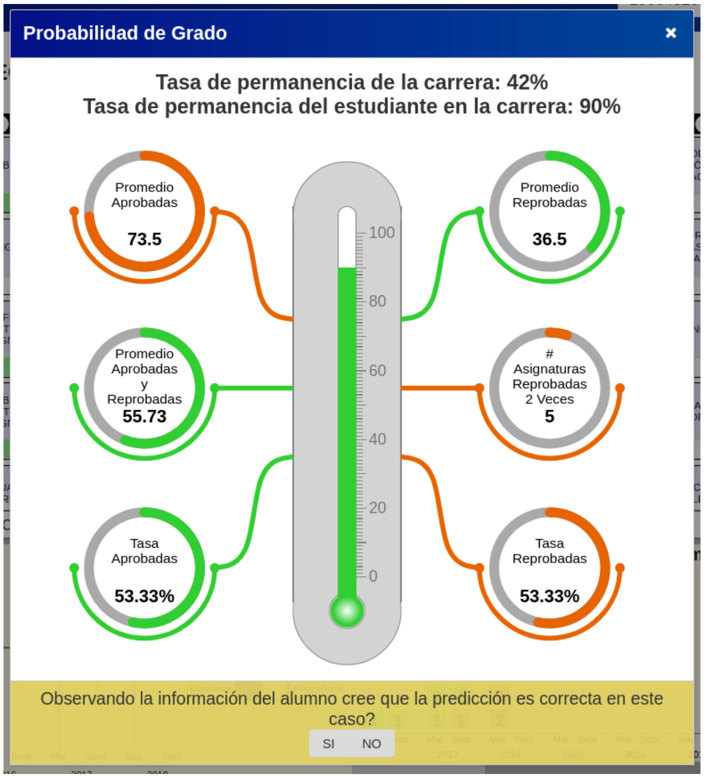


Fig. 1-6. Screenshots examples of the dropout tool for degrees

5) **OnTask**. OnTask is a tool that assists teaching staff to provide timely, personalized, and actionable feedback to students at scale. Data from different source files, such as learning management systems and student information systems, generate a table of attributes for students. These attributes can be used by the instructor to provide personalized feedback (action-out). In addition, instructors can create survey questions to get feedback from students. The responses are then included in the table of attributes that the instructor can use to provide further feedback (action-in). OnTask uses a set of 'if...then' rules to assist instructors to write personalized feedback for a large cohort of students. This can improve teaching efficiency by saving instructors time writing similar messages repetitively. It can also meet the needs of students in terms of receiving feedback in a timely manner, allowing opportunities to improve learning. Figure 1-7 gives an overview of the Ontask architecture.

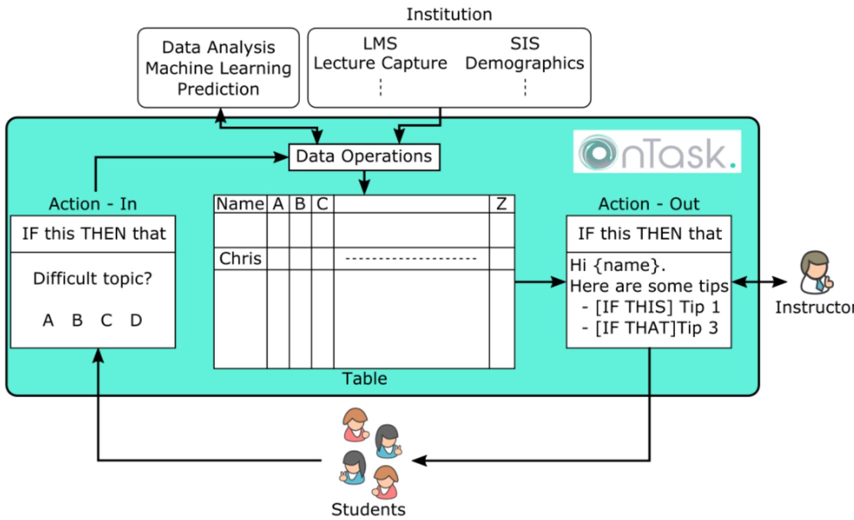


Fig. 1-7. General architecture of OnTask tool

Depending on each institutional context and needs, different tools have been developed and implemented. The following table indicates the LA tools that have been used in the context of the LALA Project for 8 different HEIs in Latin America. It is very important to point out that each tool has been adapted to meet the needs in each institution. In other words, even tools with the same purpose may have different user interfaces or use different data. In addition, the tools are not static but have been evolving during the design and pilot process, based on inputs from different stakeholders.

University /Tool	NMP: Counselling for courses	Counselling for degrees	Dropout for courses	Dropout for undergraduate programs	OnTask
PUC (Pontifica Universidad Católica de Chile)	X		X		
ESPOL (Escuela Politécnica Superior del Litoral)		X		X	
UCuenca (Universidad de Cuenca)		X		X	
UACh (Universidad Austral de Chile)		X		X	
Universidad de Chile	X		X		
UPS (Universidad Politécnica Salesiana)		X		X	
Universidad de Pernambuco					X
Instituto de Zitacauro				X	

Regarding the design, development and implementation of LA tools, the LALA Project provides:

- **A generic backend architecture** for the counselling and early dropout prediction tools for degrees.
    - Common database with the description of the required common data
    - System architecture with the description of the different components and protocols.
- **Adaptations for different partners of the general architecture to specific cases**.
- **Explanation of the design and implementation of the tools to each partner applying the LALA framework**.
- **Frontend for each tool for each partner**. The different dashboards and the different interfaces of each tool for each partner is presented.
- **The evolution of the tools during the time based on the feedback from pilots**.
- **The source code of the tools**. The source code of each tool for each university is available so that others can reuse and adapt it. This includes the source code of the frontend, the backend and scripts for database creation and for data migration.

1.3 LALA Pilot Experiences

The tools developed were piloted with four general goals:

1. To integrate LALA tools into the institutions' academic processes to improve academic decision-making
2. To develop local capacity to introduce Learning Analytics tools in the institutions involved in the LALA project
3. To collect data to assess student performance and evaluate the usefulness and impact of the piloted Learning Analytics tools in the institutions
4. To ensure the sustainability of the use of LALA tools in the universities of all Latin American partners

As mentioned before, to achieve these objectives the pilots were organized in the following five phases:

1. **Preparation**. The first phase (preparation) included the development of the piloting devices (instruments, such as questionnaires and material), the socialization of the pilot plan to stakeholders, and the training of the piloting staff.
2. **Agreement**. The second phase (agreement) enabled the generation of an agreement with the pilot participants, establishing the commitments of each stakeholder involved (teaching staff, students, etc.), and the safeguards applicable to the information gathered during the piloting.
3. **Training**. The third phase (training) involved training technicians, users, and administrators, regarding the use and maintenance of the piloted tools and the pilot activities to be performed.
4. **Use**. The fourth phase (use) allowed participants to use the tools in their academic processes while the project team offered support and, accompaniment. The phase also included sessions for socializing the experiences and a preliminary evaluation of the tools and the process.
5. **Improvement**. The last phase (improvement) is aimed for a general evaluation of the tools and the piloting. informing and documenting the lessons learned that will form part of the LALA Handbook (final product arising from the work of the LALA project).

It should be noted that the piloting phases may appear to be sequential, but in practice their execution was iterative. Therefore, during a pilot, multiple instances of preparation, agreement, training, use and improvement can occur. However, these experiences are included in a single pilot project because the objective is common, and the tool evaluated is the same.

Each partner university has conducted at least one pilot for the counselling tool and one pilot for the prediction tool. In addition, other associate institutions piloted one or several of the LALA tools. During the execution of each of the pilot phases, each of the Latin American partners was free to carry out their own implementations according to their contextual needs. The training and evaluation processes and instruments have differences among the pilots, as they respond to the context where the tools were deployed. However, there are many common aspects including the methodology.

The four tools presented in Section 2 have been piloted in the 8 Latin American HEIs. A summary of the number of stakeholders involved in each institution is provided below. The numbers in the table represent for teachers as users that had the possibility to use at least one of the tools, even if they did not use them, and for students as users for which data was analyzed and was potentially available. In other words the table shows the number of teachers that received the tool and have their accounts available and the number of students whose data was analyzed and available. In several cases, the pilot experience took place during different academic courses.

University /Number of stakeholders	Number of students	Number of teachers / counsellors
PUC (Pontifica Universidad Católica de Chile)	1.296	30
ESPOL (Escuela Politécnica Superior del Litoral)	9.485	641
UCuenca (Universidad de Cuenca)	8.300	74
UACh (Universidad Austral de Chile)	9.085	43
Universidad de Chile	1.252	4
UPS (Universidad Politécnica Salesiana)	3.668	119
Universidad de Pernambuco	112	3
Instituto de Zitacauro	2128	40
Total numbers	> 34.000	> 900

It is important to note that the different number of teachers/counsellors involved in each institution is influenced by how institutions assign counsellors. For example, UCuenca and UACH assign program directors for this role, while ESPOL and UPS assign these tasks to teachers. As generally there are more teachers than program directors in an institution, these numbers can be greater for ESPOL and UPS. It is also important to point out that the different numbers of students and teachers/counsellors involved is influenced by the initial state of the institution regarding the use of LA and its own institutional culture.

For the pilot experiences, impact, effectiveness and usefulness were measured but each partner used different instruments depending on their needs. Instruments include surveys, focus groups, interviews, logs, etc. The different artifacts and instruments for evaluating the pilot experiences are also available as a result of the LALA project.

The achievements of the pilots are summarised below:

Effectiveness

The effect of technological tools on students' effectiveness is a difficult phenomenon to measure since it depends on multiple factors and isolating them is not a trivial task. Furthermore, the effectiveness of the students can be interpreted and measured differently at each institution. For example, the effect of TrAC (UACh) on the effectiveness of the students was measured by seing how students rank with respect to their cohort. It was concluded that the students who received counselling with TrAC were better ranked in their own cohort compared to others who did not receive counselling with TrAC. In the case of PUC-Chile, an experiment with a control group was designed to measure the effects of NoteMyProgress on students. This experiment allowed to observe a positive correlation between the active use of the tool and the completion of the MOOCs. In the case of UCuenca and ESPOL, effectiveness was measured through the differences in grades and academic load of the students. Positive differences were obtained in both metrics.

In summary, there were positive effects on the effectiveness of students who received advice with the LA tools. However, we are conscious that these improvements can be attributable to multiple factors, among which the incorporation of LA tools may be just one of them.

Utility

The usefulness or utility of the tools was measured through questionnaires, focus groups and interviews. In some of the universities, several of these strategies were used to triangulate the information. In all universities the results were positive. In particular, users value the design attributes of the tools, their ease of use, and above all their impact on their daily tasks. For example, some users mentioned that because of the tools they could use their time more efficiently, and that the information presented in the tools supports them in better explain the decisions they make alongside being more confident in those decisions. In addition, the tools have made it possible to better guide students when planning for courses. The logs of the use of the tools are concrete evidence that users have actively used the tools by performing multiple actions on them.

Institutional impact

This aspect is perhaps the most challenging one. All universities participating in the pilots reported difficulties in: obtaining the commitment of the university authorities to actively participate and allocate resources in the institutionalization of the tools; materializing the exchange of data between existing applications in the university; supporting from the management regarding data management dilemmas, their possible interpretations and their impact on the processes involved (counseling and self-monitoring). However, the project also raised awareness in the authorities regarding the importance and benefits derived from incorporating LA. This is materialized in various concrete actions. For example, at UACh the Director of Undergraduated Programs supported the request for resources as part of the annual IT budget to afford the institutionalization of TrAC. In PUC-Chile, the piloted tools are part of an institutional modernization initiative supported by the director of the School of Engineering. In UCuenca, the rectory assigned resources for the adaptation of the tool and they continue to be assigned to improve implementations and progressively adding new faculties. In ESPOL, the results derived from the use of SiCa were positively received by the vice-rector's office and its institutional use is encouraged.

1.4 Troubleshooting

In this section we summarize the best practices that were extracted from the project experience, described as solutions for some defined problems/challenges.

Problem	**Description**	**Dimensions**	**Solutions/recommendations**
Users are reluctant to use the tool because it demands additional work	Both during the pilot and in the subsequent use of the tool, we have experienced resistance from users in several cases. There may be little participation because users have limited availability (eg high workload) to incorporate new technological tools.	Institutional Technological Communal	Involve all stakeholders early and together to build trust Provide evidence that the tool improves processes, makes specific tasks easier and / or faster. Look for enthusiastic users first, who provide feedback that allows "polishing" the tool and who are also useful testimonials and promote the tool to their peers Invest what is necessary to incorporate the tool into existing systems that they already use. This will simplify access.
Scaling / adoption of the tool is not achieved at the institutional level	The piloting was successful, but the scaling / adoption of the tool at the institutional level has not been achieved because there were not enough political/managerial will to allocate the necessary resources for it.	Institutional	Get a project sponsor with decision-making power. It is important to have evidence of the potential impact of the piloted tool. The recommendation is to collect objective and subjective information (usage data, usability surveys, satisfaction), or other instruments for the perception of utility and impact.
I don't know which LA tool to adopt	When choosing an LA tool we find multiple options and / or ideas to design new tools.	Institutional Technological	Although user needs are key to selecting an LA tool, it is advisable to start with the one that best suits the data and processes that the

			organization already has and performs. This strategy has the advantage of focusing on the expectations of the stakeholders, allowing the generation of concrete results and deliverables quickly. Consequently, it increases both the credibility of the LA team and the possibility of leveraging resources.
Data has been provided without anonymization	Some of the data provided by the key stakeholders has been made available without anonymization and shared publicly.	Institutional Ethical Technological	Identify status of the regulations on privacy and information security. If necessary, annonymize the data before using it. This approach adds a level of privacy, although it does not ensure security.
Lack of budget for adaptation of tools	The representative of an institution interested in using the tools developed in LALA has defined a budget only for the piloting phase because it assumes that the existing tools can be implemented directly.	Institutional Technological	Moderate adoption expectations because adaptation to the context is always required. Adapting external tools to the existing processes in the institution is a good strategy, at least when starting out, because it reduces resistance to change. But this strategy must be agreed with the authority in order to commit the necessary resources for adaptation.
It is difficult to quantify and evaluate the ethical impacts of data processing.	Learning analytics solutions are difficult to quantify in terms of their impact and also have ethical issues due to the handling and analysis of sensitive data.	Institutional Ethical Communal	Keep stakeholders and the community informed about the progress and impacts of the project, highlighting the ethical aspects of the data. Share the good stories!
I don't know what characteristics the LA team should have	A Learning Analytics team is being formed at the institution. How to define what skills and experiences are necessary when forming such a team?	Institutional Technological	Establish a stable team with multidisciplinary skills that allows understanding the needs of users, but also with technical and management skills and knowledge of the educational and institutional context. Although it can sometimes be difficult to form teams with these characteristics, it is important to have at least sporadic participation

			of people with relevant particular skills.
Lack of knowledge regarding current legislation, or lack of ethical commitments on data usage or processing.	Teachers are interested in having as much information as possible from their students, in order to support their learning processes. However, some do not realize that this can violate the privacy of students. The treatment of data by the technological team tends to depart from good ethical treatment practices, risking the publication of sensitive data or generating biased models.	Institutional Ethical Technological	Take care of the privacy and treatment of data through explicit compliance with national and international legislation, as appropriate, and ethical commitments to the well-being of people. The regulations on privacy and protection of information are changing, so it is good to be cautious. Put additional effort into anticipate requirements in this regard. For example, a strategy that has been key in some cases is to handle only anonymized information from the source. Involve the IT department, because since they are responsible for maintaining the databases, they are often the first to take action to protect sensitive data
We are unable to correctly interpret user requirements	The requirements survey was carried out with some users of a particular unit, then we understood that the needs expressed by those users did not represent all the units.	Institutional Technological Communal	One strategy to mitigate this risk is to generate low fidelity prototypes and discuss them early with a wide variety of users. Above all, balance between enthusiastic users and detractors to be able to attend to the different needs
It has not been possible to guarantee that the data used by LA tools is up to date	Although an automated information gathering process has been defined, the origin of the data does not correspond to the system in production.	Institutional Technological	Establish policies and protocols where migration schedules are defined and that do not affect the performance of academic systems in production. For this to materialize, it is vitally important to have the support of institutional decision-makers in order to formalize the protocols.
The data used to test the tool does not represent the	Although there are real data, these only represent a part of the institutional reality. If you want to have access to more	Technological Communal	It is recommended that the data and results delivered by the tools be analysed before any intervention

diversity of the organization	data, it must be done in the production environment.		with the end users, as an error can reduce the credibility of the tool. If this is not possible, it is vitally important to at least carefully define the messages and recommendations that the tools shows. In this way it is possible to warn the user of possible problems caused by the data.

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Main related publications to the LALA project

i) <u>About the LALA framework</u>

1) **Identification of needs:** Hilliger, I., Ortiz-Rojas, M., Pesántez-Cabrera, P., Scheihing, E., Tsai, Y. S., Muñoz-Merino, P. J., Broos, T., Whitelock-Wainwright, A. & Pérez-Sanagustín, M. (2020). Identifying needs for learning analytics adoption in Latin American universities: A mixed-methods approach. The Internet and Higher Education, 45, 100726.

2) **Adoption of learning analytics solutions:** Hilliger, I., Ortiz-Rojas, M., Pesántez-Cabrera, P., Scheihing, E., Tsai, Y. S., Muñoz-Merino, P. J., Broos, T., Whitelock-Wainwright, A., Gasevic, D., & Pérez-Sanagustín, M. (2020). Towards learning analytics adoption: A mixed methods study of data-related practices and policies in Latin American universities. British Journal of Educational Technology.

3) **Policy making:** Broos, T., Hilliger, I., Pérez-Sanagustín, M., Htun, N. N., Millecamp, M., Pesántez-Cabrera, P., Solano-Quinde, L. Siguenza-Guzman, L., Zúñiga-Prieto, M.A., Verbert, K. & De Laet, T. (2020). Coordinating learning analytics policymaking and implementation at scale. British Journal of Educational Technology.

ii) About LALA Adoption and adaptation of tools

4) **Counselling dashboard design**: Hilliger, I., De Laet, T., Henríquez, V., Guerra, J., Ortiz-Rojas, M., Zuñiga, M. Á., ... & Pérez-Sanagustín, M. (2020, September). For Learners, with Learners: Identifying Indicators for an Academic Advising Dashboard for Students. In European Conference on Technology Enhanced Learning (pp. 117-130). Springer, Cham.

5) **Counselling tool:** Guerra, J., Scheihing, E., Henríquez, V., Olivares-Rodríguez, C., & Chevreux, H. (2019, September). TrAC: Visualizing students academic trajectories. In European Conference on Technology Enhanced Learning (pp. 765-768). Springer, Cham.

6) **Counselling tools**. Ortiz-Rojas, M., Maya, R., Jimenez, A., Hilliger, I., & Chiluiza, K. (2019, October). A step by step methodology for software design of a learning analytics tool in Latin America: A case study in Ecuador. In 2019 XIV Latin American Conference on Learning Technologies (LACLO) (pp. 116-122). IEEE.

7) **Prediction tool in MOOCs:** Moreno-Marcos, P. M., Muñoz-Merino, P. J., Maldonado-Mahauad, J., Pérez-Sanagustín, M., Alario-Hoyos, C., & Delgado Kloos, C. (2020). Temporal analysis for dropout prediction using self-regulated learning strategies in self-paced MOOCs. Computers & Education, 145, 103728.

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9) **Tools at UACh**: Chevreux, H., Henríquez, V., Guerra, J., & Scheihing, E. (2019, September). Agile development of learning analytics tools in a rigid environment like a university: Benefits, challenges and strategies. In European Conference on Technology Enhanced Learning (pp. 705-708). Springer, Cham.

iii) <u>About LALA pilots</u>

10) **Evaluation of counselling dashboards** Guerra, J., Ortiz-Rojas, M., Zúñiga-Prieto, M. A., Scheihing, E., Jiménez, A., Broos, T., ... & Verbert, K. (2020). Adaptation and evaluation of a learning analytics dashboard to improve academic support at three Latin American universities. British Journal of Educational Technology.

Chapter 2: The final version of the LALA Framework

This chapter presents the final version of the LALA framework, which has introduced changes and improvements from the original version of the LALA framework based on the feedback received by the pilots, external and internal reviews.

Learning Analytics (LA) strives to develop different methodologies, techniques and technological tools for the analysis of educational data (Siemens & Baker, 2012). This line of work has grown strongly in the last decade (Arnold et al., 2014, Ferguson et al., 2016), both due to the progressive accumulation of data and the urgent need to optimize teaching and learning processes (Gašević & Dawson, 2015). In fact, in recent years, higher education institutions have begun to explore how learning analytics can be integrated as part of their processes - from methodologies for data capture and management, to the technological tools needed for their manipulation.

In the current literature, most of the studies published in this line have been oriented toward the development of models and technologies to visualize descriptive or predictive data in relation to student performance (Arnold et al., 2014; Ferguson et al., 2016; Gašević & Dawson, 2015). However, the reality is that the adoption of these models and technologies is still scarce. On the one hand, existing methodologies and tools do not always present relevant information to provide feedback for the teaching and learning processes (Bodily & Verbert, 2017; Gašević & Dawson, 2015), or institutional management processes in higher education or on other educational levels (Ferguson et al., 2016). On the other hand, the studies that evaluate and validate this type of methodologies and tools are scarce, and their evaluations are limited to specific aspects for a limited period of time (Arnold et al., 2014, Ferguson et al., 2016, SOLAR, 2017), without necessarily assessing the needs of its users (Bodily & Verbert, 2017).

Therefore, higher education institutions must work to further the adoption and incorporation of LA tools in their processes. For example, institutions must transform their data capture and processing processes to take into account ethical and privacy considerations that affect the use of educational data at the institutional level (Drachsler & Greller, 2016; Y. Tsai, Moreno-Marcos, Tammets, & Gasevic, 2018). To facilitate these processes, institutions must have practical guides and methodologies, as well as exemplary case studies that can guide them on how to benefit from existing learning analytical tools (Colvin, Dawson, & Fisher, 2015; Ferguson et al., 2016).

In Europe, there has been work done in this line and frameworks have been developed to guide institutional policies in higher education so that they anticipate the implications of adopting LA in different areas (Y. Tsai & Gasevic, 2017). One of these frameworks has been developed by the SHEILA project, a project funded by the European Union that aims to propose a framework to support higher education institutions in the adoption of LA (Y. S. Tsai et al., 2018). In Europe, there are already initiatives that advocate the good management of data in terms of ethics and privacy. In this area, the Great Britain's Joint Information System Committee (JISC) published a code in 2015, addressing the aspects such as: legal responsibility and ethics on data, transparency criteria, and consent policies for the purpose of protecting privacy, validity, and access to educational data for effective interventions.

However, in Latin America, efforts to adopt LA have been isolated. Some Latin American universities have started to measure and optimize teaching and learning processes through LA, but these attempts are still on a small scale (Lemos dos Santos et al., 2017). Additionally, the region lacks a community to exchange ideas, methods, and tools because of the limited availability of experienced researchers in this field (Cobo & Aguerrebere, 2018; Lemos dos Santos et al., 2017).Therefore, it is necessary to create a community that promotes the exchange of ideas, methodologies and tools in the region (Lemos dos Santos et al., 2017). For that, there is a need of guiding frameworks that facilitate the development and adoption of LA in this region.

Given the current context of LA adoption in Latin America, and the difference in maturity in this area compared to Australia and Europe, these guidelines should contemplate different aspects ranging from the creation of institutional strategies (as was done in the SHEILA project for Europe), to technological aspects to support the integration of analytical tools, aspects on data treatment ethics, and communal aspects to generate interest groups in the region. Further, these frameworks has to be based in existing models and frameworks, but also adapted to the Latin American context to address the main challenges that Higher Education institutions of this region are facing: installing new forms of educational quality and accountability, reducing disparities in program quality, reducing dropout rates, and bridging the gaps in existing regulatory policies (Cobo & Aguerrebere, 2018; Ferreyra et al., 2017; Knobel & Bernasconi, 2017).

In order to support the development and adoption of learning analytics in Latin America, this document presents the LALA framework: a methodological framework to guide the design, implementation and use of learning analytics tools in higher education institutions in Latin America as well as to identify the main actors and organizational needs to facilitate their adoption. Specifically, the framework is composed of four fundamental dimensions: (1) the institutional dimension, which considers the current and desired state of the institution in relation to the adoption of LA; (2) the methodological dimension, which considers the technical needs for the design and implementation of LA tools in the institution; (3) the ethical dimension, which considers the necessary guidelines for the ethical use of the data; and (4) the community dimension, which proposes a series of guidelines for the institution to join an international LA community to access support for research and development in this area. Each of these dimensions is addressed in a manual, and each manual describes the methodologies and instruments to support different processes.

This framework has been developed in a joint work with Latin American and European universities, taking as a reference the outcomes of thethe SHEILA - Supporting Higher Education to Integrate Learning Analytics – project (Tsai et al., 2018) and other European works. This collaboration has made it possible to benefit from the knowledge acquired by European institutions and adapt it to the Latin American needs to promote the implementation of LA in this region.

One of the results of the SHEILA project is the SHEILA framework (http://sheilaproject.eu/sheila-framework/). The SHEILA Framework was created using as a reference the ROMA-RAPID Outcome Mapping Approach framework which was developed more than a decade ago by the Overseas Development Institute (ODI) to improve the development of policies and influence the change of institutions (Young et al. al., 2014). This framework proposes an iterative six-step process: 1) draw up a map of the political context, 2) identify key actors, 3) identify desired behaviors, 4) develop a change strategy, 5) analyze internal capacities and 6) establish a plan of measurement and evaluation of what has been learned (Overseas Development Institute, 2009). These steps were designed so that any institution can implement them, regardless of the degree of progress of a certain institutional policy (Young et al., 2014). The SHEILA Framework (Figure 2-1) defines three axes to be considered in the development of

Learning Analytics policies: action, challenges and policies (Tsai, Moreno-Marcos, Tammets, and Gasevic, 2018).

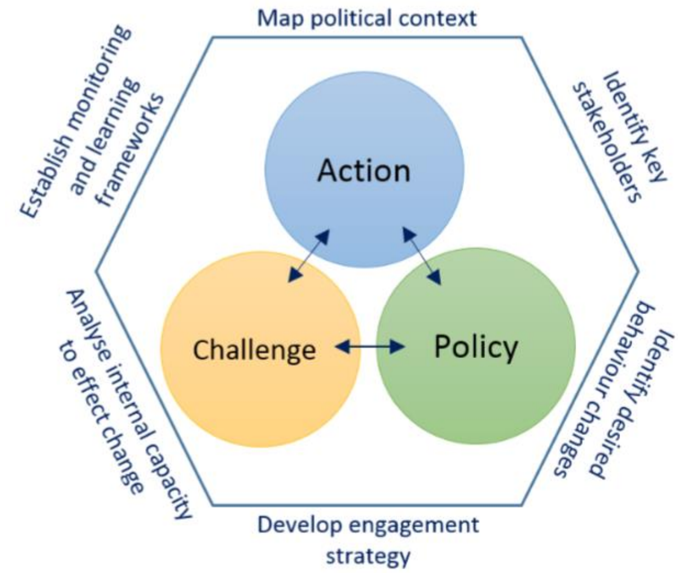


Figure 2-1 SHEILA Framework, based on the ROMA Framework. This framework is taken as reference for the construction of the institutional dimension manual for the LALA framework.

The SHEILA framework was created from data collected from different higher Education institutions in Europe, so its application in Latin America cannot be directly made. However, in the LALA project, the SHEILA framework was taken as a methodological framework and a starting point to propose a framework adapted to the needs of the Latin American region. In addition, other instruments from the SHEILA project such as the surveys and focus groups to different stakeholders were taking into account as a starting point. The objective of using this same methodology is to take advantage of the lessons learned from the SHEILA project to propose e.g. a workplan that identifies the institutional needs in relation to learning analytics in Latin American institutions.

To date, there is no report that offers a general and specific overview of the steps to be followed by a Latin American institution interested in adopting LA and tools based on LA. Therefore, this document is the first practical guide in this line. Moreover, compared with other existing models for LA adoption such as SHEILA, the LALA framework proposes a different approach that includes, not only a mechanism to identify LA institutional needs and actions, but also a set of guidelines need to be considered for the technological and organizational needs of the organization when developing a LA project.

This chapter presents the reviewed proposal of the LALA framework excluding its validation. Based on the external review, tests and developments performed throughout the project, the LALA framework has been reviewed in order to improve and adapt it to the needs detected throughout the project..

Because its development is based on the experiences of institutions in Chile and Ecuador, this guide is oriented to the management of higher education institutions in Latin America. However, this work has been protected by Creative Commons (CC) with the objective of facilitating its adaptation and use for other contexts.

2.1- Objectives of the LALA framework and chapter structure

This chapter presents an update of the first LALA Framework Deliverable. The general objective of the LALA framework is to provide guidelines for higher education institutions in Latin America in the design, implementation and adoption of learning analytics technological solutions and processes. In addition, it promotes the membership of institutions in a regional LA community to exchange good practices regarding the use of data and tools.

To ensure both objectives are achieved, the LALA framework has been developed. This framework has been conceived as a set of methodologies and instruments to facilitate and promote the design, implementation and adoption of learning analytics tools at institutional level. These methodologies and instruments are organized in 4 dimensions: (1) the institutional dimension, related to the political and strategic aspects of the institution as well as their internal abilities regarding learning analytics; (2) the technological dimension, related to the technical aspects associated with the design and implementation of technological tools; (3) the ethical dimension, related to the ethical aspects of data treatment and management; and (4) the community dimension, related to the generation of a research community and good practices regarding learning analytics in Latin America. In addition, a series of case studies from 4 different Latin American institutions are presented to exemplify its application as a complement to the framework. Unlike other projects, such as the European project SHEILA, this deliverable contemplates the construction of a framework that goes beyond the institutional dimension, including important dimensions such as technology and ethics, both not yet considered in the region. In addition, through the communal dimension, the construction of an LA community for Latin America is contemplated, a region in which there are still no scientific initiatives and good practices in this area of knowledge. The objective is to start building this community from the countries represented in the project, and then extend it to other countries in the region.

This document describes the new version of the LALA framework detailing each of the dimensions and the relationships that exist among them. First, an overview of the LALA framework is offered, highlighting its objective and structure as well as the two different ways that is meant to be used: using the dimensions independently or using them jointly through an integrative workflow. Second, the four dimensions are presented. Each dimension is presented in the form of a practical guideline indicating its objective, the methodology used for its design, a work plan describing step-by-step the activities to be followed to take into account the aspects related to this dimension, resources for supporting these activities, and the evaluation of its main results. All resources are in the APPENDIX of this document and the online folder: https://www.lalaproject.org/results/annexes/. Then, two sections are presented with the results of applying the LALA Framework with the Latin American institutions partners. First, we present the results of applying the Institutional dimension independently. Next, we present how the four institutions applied the integrated workflow for designing and implementing their LA initiatives. Finally, in the conclusions section, the main contributions of the LALA framework are highlighted, as well as a discussion on the following steps proposed to continue iterating on the framework.

2.2- LALA Framework: Overview

2.2.1 LALA Framework Objective

This section presents an overview of the LALA framework and its four dimensions, with the objective of supporting the development of LA in higher education institutions in Latin America.

2.2.2. LALA Framework Dimensions

The framework is structured in four dimensions to be considered in the process of design, implementation and adoption of learning analytics tools:

1. The Institutional dimension. It considers a series of phases and activities to understand what the current state and the desired state of the institution are in relation to policies and strategies for the incorporation of learning analytics tools in the institution.
2. The Technological dimension. It addresses technological aspects of the process of adopting (implementing or adapting) a learning analytics tool at institutional level, taking into consideration the detection of a need, the design of a model or prototype, its testing and its evaluation for its final scaling. In addition, this dimension incorporates a series of guidelines to ensure adequate collection and management of educational data, as well as the management of adequate infrastructure and technological capabilities to support the implemented tools.
3. The Ethical dimension. It proposes a series of considerations to protect the privacy of students and teachers, maximizing the benefits associated with the use of educational data and minimizing the possible risks of their manipulation.
4. The Community dimension. It provides guidelines to promote the exchange of results and experiences with other higher education institutions, encouraging collaboration without compromising internal information and promoting a community for research and development of this area in the region.

Each dimension has been created independently and using different methodologies.

2.2.3. How to Use the LALA Framework

The Framework is meant to be used by any person interested in developing a solution or initiative of LA in a Latin American Institution. From managers to teachers or researchers, this framework can serve as a guideline to define a particular LA solution or technology or a strategic plan related to LA for the institution.

Each of the dimensions in the framework can be used independently depending on the needs and interests of each institution. However, they can also be used in an integrated manner, and for this second case, we propose a process in different phases in which different aspects of the dimension can be used iteratively in a process of four phases: the Diagnostic phase, the Design/prototyping phase, the Piloting phase, and the Scaling up Phase.

An overview of the four dimensions and how they can be used independently are presented in subsection 2.2.3.1, while the four-phase workflow for using the dimension in an integrative manner is presented in subsection 2.2.3.2.

2.2.3.1. Independent use of the LALA framework dimensions

Figure 2-2 shows the four dimensions of LALA framework. When used independently, each of the dimensions leads to a particular result that can be used by the institution at any context and project related to LA. Each dimension is described and organized in a work plan that guides the user through a set of activities and the resources needed to implement the dimension in their institution. Also, a set of methods are proposed to evaluate the data collected in each of the activities to extract the expected results. Figure 2-2 shows the main question addressed in each dimension, as well as the main results obtained when applying each of the activities, resources and evaluation mechanisms described in the workplan.

This section summarizes the work plan for applying each of the dimensions, but the details in each of the activities, as well as the resources, and evaluation methods are described in section 4 for the Institutional Dimension, section 5 for the Technological Dimension, section 6 for the Ethical Dimension, and section 7 for the Community dimension.

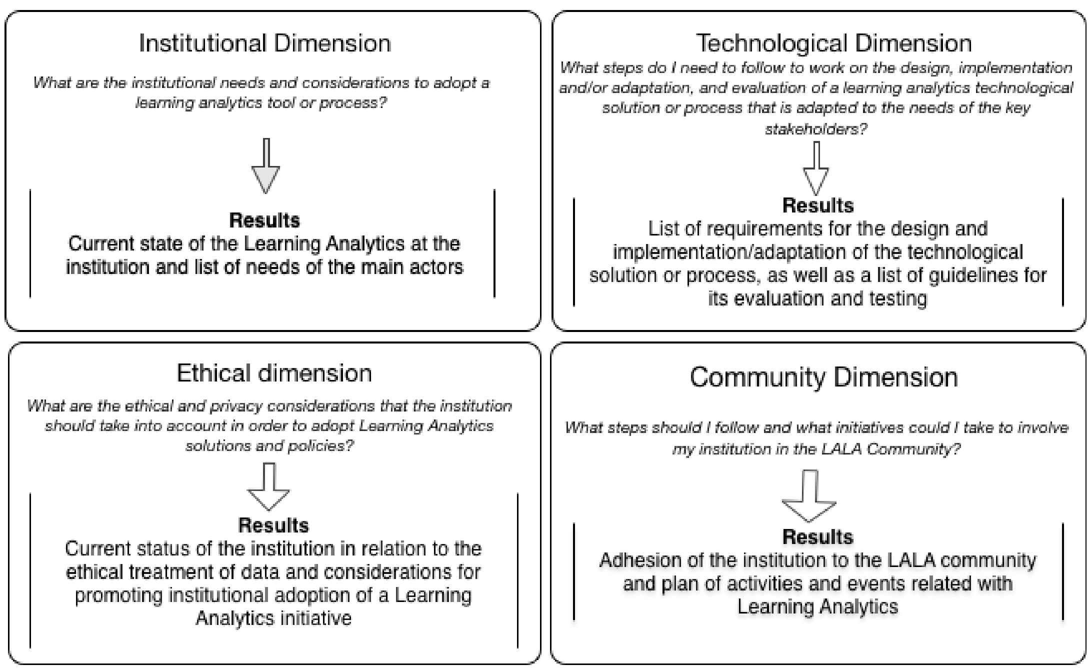


Figure 2-2 LALA framework manuals, considering the four main dimensions: institutional, technological, ethical and community.

- The **Institutional dimension** will allow the institution to obtain a perspective of the current state of adoption of LA and of the processes related to the LAs currently installed, and thus establish the ideal state which they want to reach from the perspective of all the stakeholders involved (students, teachers, and managers). The application of the Institutional dimension involves four **activities**: 1) performing an institutional diagnosis, 2) understanding the political context and institutional needs, 3) identifying what is expected from the use of educational data, 4) developing a change strategy The main **result** of this dimension is a list of the needs of the institution and its main actors in the form of strategic lines to reach a desired state.

- The **Technological Dimension** proposes a set of activities to implement and evaluate learning analytics tools that can solve the list of needs identified in the Institutional dimension. With the intervention of developers and researchers - in addition to students, teachers and/or managers – a series of activities are proposed to identify the main requirements that these tools must meet to cover the identified needs. The **activities** for the application of this dimension are: 1) to identify what type of technological considerations are required to implement these tools (considering institutional resources), and 2) to conduct a pilot evaluation of the tools designed. The main **result** of this dimension is a pilot tool evaluated in a real context.
- The **Ethical dimension** proposes a series of ethical considerations in relation to the data use and its policies based on existing literature. This dimension includes as its main resources templates for informed consent and data use agreements that can serve as an example to the institutions that use it. The application of this dimension consists on the following activities: (1) review the literature and regulations on ethical and privacy considerations in the design and implementation of learning analytics, (2) anticipate ethical and privacy considerations for the design and implementation of an learning analytics tool at the institutional level (using phases 2 and 3 of the institutional manual), and (3) define a strategy to adapt considerations in the literature and in national and international regulations to the institutional context. The main **result** of this dimension is a set of ethical procedures related to LA.
- The **Community dimension** provides information on how an institution can join the LALA Community and develop activities and plans in order to generate a LA culture. This dimension can be seen as an envelope that can support any of the activities around LAs in the institution by providing ideas, case studies and activities that help stakeholders get involved in the Learning Analytic community at a regional and international level. The **activities** for the application of this dimension are: (1) get informed about the LALA community, (2) register in the LALA community as a researcher or as an institution, and (3) plan activities related to LA in your institution. The main **result** of this dimension is to get involved with the LALA community and share knowledge with other institutions.

2.2.3.2. 4-phase Workflow for integrating all LALA framework Dimensions

Another way to use the LALA Framework is considering all its dimensions in an integrative manner. For that, we propose a 4-phase workflow which aims at providing some guidelines on how to use and combine the different dimensions of the LALA Framework when designing and implementing a LA technological solution or processes.

The main characteristic of this integrative workflow is that it conceives the design and implementation of the LA solution as an iterative process that might involve considering different elements of the LALA framework in each phase. Moreover, the workflow proposed builds upon the idea that, designing or implementing a LA initiative requires the orchestration of bottom-up approaches (initiatives that emerge from the daily needs of people in the institution such as teachers or students and might be initially applied at a small scale but grow organically thanks to the participation of different stakeholders and can be finally adopted at large scale,) with initiatives top-down, that are initiated by stakeholders having a leadership role, such as managers or higher education directors, which might apply it to a large scale and communicate these solutions to the different involved stakeholders in the institution. That is, this workflow considers that combining bottom and top down approaches is a good mechanism for LA initiatives that could potentially be completely integrated and in the institution and adopted by its stakeholders.

The integrative workflow is divided into 4 phases (Figure 2-3):

1. Diagnostic phase: dedicated to understanding what the needs of the institution in terms of LA are. This phase is directly related with the Institutional Dimension of the LALA Framework, but could also imply using some elements of the Ethical and Technological Dimensions.
2. Design/prototyping phase: dedicated to understanding how the institution conducted the design and implementation of the LA technological solution or process to face the needs identified in the Diagnostic phase. This phase is tightly related with the Technological Dimension of the LALA framework, since it might consider the evaluation plan defined in this dimension, but it might also take into consideration certain elements of other dimensions such as the Ethical or the Institutional.
3. Piloting phase: dedicated to understanding what instruments and actions were undertaken to conduct the pilot studies and the results of these studies. This phase is tightly related with the Technological Dimension but might also involve taking information captured through the Institutional and Ethical dimensions of the framework, or involving people related with the Community dimension for analysis purposes.
4. Scaling up: dedicated to understanding what the institutional actions conducted to scale the LA solution and incorporate it as part the institutional processes were. This phase is tightly related with the Institutional dimension in order to see how the institution has been transformed with the LA initiative. However, it might also involve considering aspects related to dimension such as the Ethical or the Technological, for evaluation purposes.

No specific guideline is provided on what is the dimension of the LALA Framework that should be used at each phase, since the resources they provide can be used in any of them depending on the context. However, and in order to give some examples on how this process can be applied, we show in Section 9 what were the dimensions and resources that the 4 different Latin American institutions used in each of the phases.

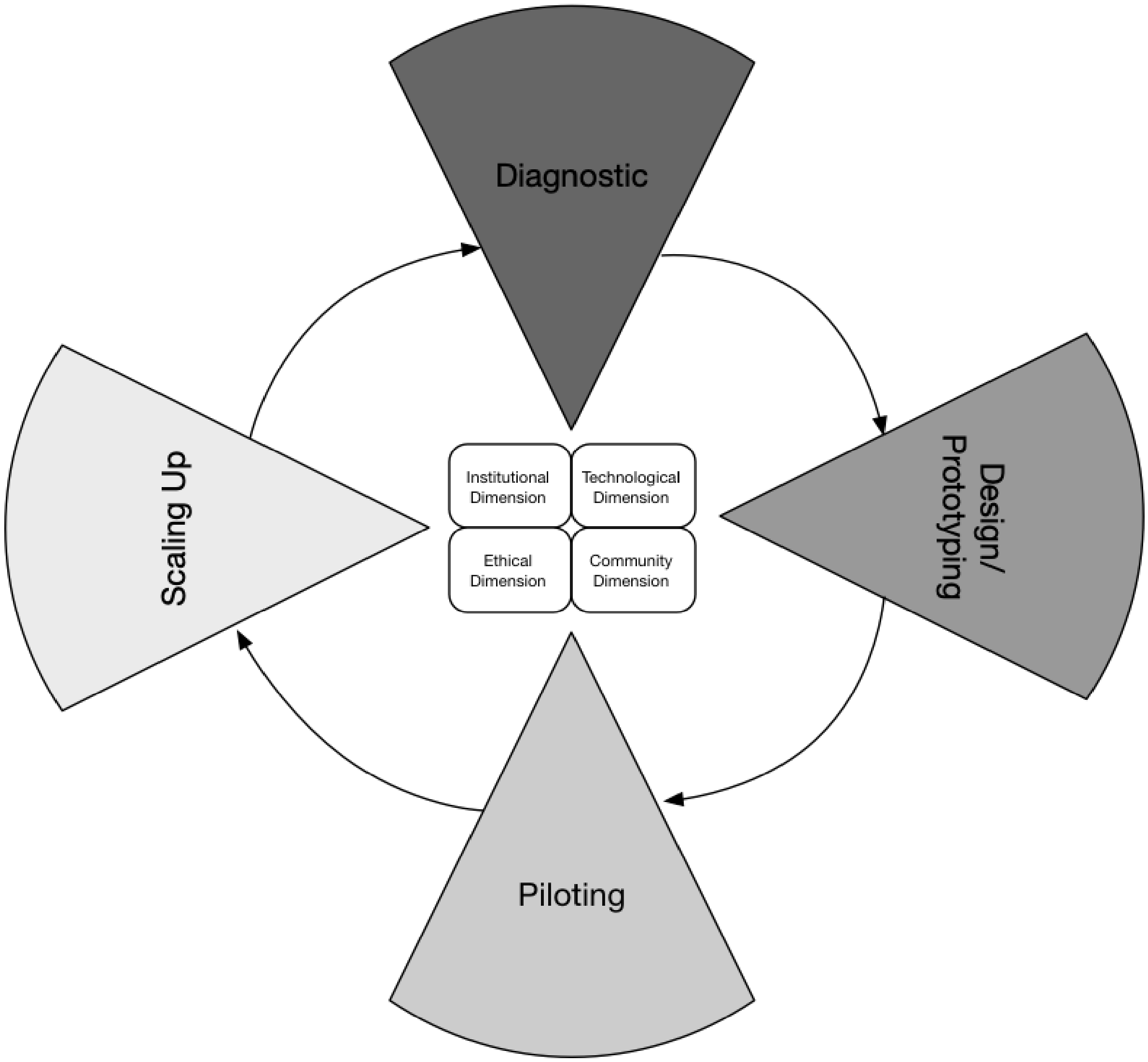


Figure 2-3 LALA Framework Integrated Workflow

2.3- Institutional Dimension

This section presents the institutional dimension (Figure 2-4). It describes its main objectives, its general vision, the methodology used to define it, and the work plan for applying it, including the description of the resources needed for its application and the expected results and evaluation.

2.3.1. Objectives

The institutional manual of the LALA framework aims to promote the participation and commitment of key stakeholders in the adoption of LA solutions, anticipating political and strategic aspects. Specifically, it proposes activities to understand what the current state and the desired state of the institution is in relation to the incorporation of LA tools, as well as the policies and strategies established for the management of educational data. That is, this dimension considers all the institutional context or structure as well as the planning directions or strategy on LA.

As key stakeholders, the LALA framework defines the students, academic staff or teachers, and leaders (persons who might influence the strategy and policies of the institution such as the regional governors). However, in some situations, other stakeholders might be considered, depending on the context of application.

The application of the manual will answer the question: What are the institutional considerations to adopt a LA tool or process? More specifically, it will allow the key actors of the higher education institution to:

- To detect needs that could be covered by a recurrent analysis of data on the performance of students and their teachers.
- Assess whether these needs require the design and/or implementation of an LA tool.
- Establish the objectives to be addressed in the institution with the application of LA.
- Define a strategy to design and implement an analytical tool, as well as promote its use from training courses to students and teachers.
- Anticipate the expectations and ethical considerations necessary for the use of an analytical tool at the institutional level, establishing objectives for the institution and involving key actors.

The main result of the application of this manual will be a list of needs of the main actors of an institution in the form of strategic guidelines to reach a desired state in terms of adoption of LA.

2.3.2. Overview

The application of the Institutional dimension involves four activities: 1) performing an institutional diagnosis, 2) understanding the political context and institutional needs, 3) identifying what is expected from the use of educational data, 4) developing a change strategy (Figure 2-4).

Institutional Dimension
What are the institutional needs and considerations to adopt a learning analytics solution or process?
Workplan
1. Perform an institutional diagnosis 2. Understand the political context and the institutional needs 3. Identify what is expected from the use of educational data 4. Develop a change strategy
Resources
• LALA Canvas • Protocol for interviews with institutional leaders, teachers and students • Online questionnaire for students and teachers • LALA template
Evaluation and Expected Results
Current state of the Learning Analytics at the institutions and list of needs of the main stakeholders.

Figure 2-4 Institutional dimension workflow and resources

As in the SHEILA project, the steps proposed in the ROMA (Rapid Outcome Mapping Approach) framework are approached at the dimensional level, but in different order and depth. This is because it has been adapted to the reality of the Latin American context, where something more guided by the level of development of the institutions is required. At the same time, each activity consists of one or several tasks accompanied by a series of instruments. Table 2-1 summarizes the activities, resources, as well as the instruments used, their nature (quantitative or qualitative, group or individual) and whether applied in person or online. The following sections detail the activities, as well as the resources that are used.

Table 2-1 Institutional dimension activities, with its corresponding resources and instruments,

Activities	Resources	Dimensions Analyzed	Instrument Type	Result
1. Perform institutional diagnosis	LALA Canvas	• Change strategy • Desired behaviors • Internal capabilities • Political context • Influential actors • Measurement and evaluation plan	Qualitative/ Group (application in person)	A general diagnosis about the current state of the institution regarding learning analytics identifying key stakeholders and needs
2. Understand the political context and institutional needs	Protocol for interviews with institutional leaders, teachers, and students.	• Current state of LA adoption • Desired state of LA adoption • Challenges for LA adoption	Qualitative/ Individual and in person (institutional leaders) Qualitative/ Group and in person (professors and students)	A description of the state of data, actions, policies necessary to adopt LA
3. Identify what is expected from the use of educational data	Online questionnaires for students and teachers	• Normative expectations about privacy and the use of educational data • Predictive expectations about privacy and the use of educational data	Quantitative/ Individual (online application)	Frequency tables regarding what professors and students expect from the use of their data

2.3.3 Work plan Application

2.3.3.1 Activity 1. Perform Institutional Diagnosis

Objective: To obtain a general diagnosis about the current state of the institution regarding learning analytics around the 6 dimensions of the ROMA Framework: (1) Strategy for change; (2) Desired behaviors; (3) Internal capabilities; (4) Political context; (5) Influential actors; and (6) Measurement and evaluation plan. Activity: Application of LALA Canvas ● **Resources: LALA Canvas (APPENDIX A.1.1)** ● **Time for the activity: 1.5 hrs.**

Resources: the LALA CANVAS

The LALA Canvas is a template used to guide a group discussion about the current state of a higher education institution in terms of LA (Figure 2-5). Its main objective of this template is to collect qualitative information from the different stakeholders of the institution participating in the definition of the LA initiative or affected by it about what is the state of the institution in relation to LA. The LALA Canvas is composed by six dimensions that need to be fulfilled for getting an accurate idea of what the current state of the institution regarding LA is and what the institution wants to achieve. Each dimension is accompanied by a brief description and an example so as to guide the reflection and discussion:

1. **Desired behaviors:** Refers to the expected behaviors needed to improve or achieve an expected result regarding a LA solution or initiative at an institutional level.
2. **Change strategy:** Refers to the analysis of existing policies and actions to ensure that an intervention contributes to the generation of the expected results regarding the LA initiative. In the context of learning analytics, actions could involve the definition of data management policies under technical and ethical considerations, as well as the generation of new internal abilities.
3. **Internal abilities:** Refers to the analysis of processes, human resources and available tools to generate the expected results from an intervention in an institution. In the context of learning analytics, this dimension could represent the processes of collecting educational data, infrastructure and the availability of competent people for analysis and dissemination.
4. **Political context:** Refers to the analysis of the structures or processes (external or internal) that currently affect the management of the change of an institution. In the context of learning analytics, there may be regulations that affect the management of educational data (external legal structure), or internal processes for evaluating academic or teaching performance (internal processes).
5. **Influential actors:** Refers to the identification of people and organizations that currently intervene directly and indirectly in the management of an institution. In the context of learning analytics, these actors are the ones who intervene in the management of educational data, either as beneficiaries or managers.
6. **Measurement and evaluation plan:** Refers to the indicators, instruments and information collection instances that are used to evaluate whether an intervention at the institutional level has generated the expected results. In the context of learning analytics, these indicators could be metrics obtained from the use of educational data in the instances established by the institution.

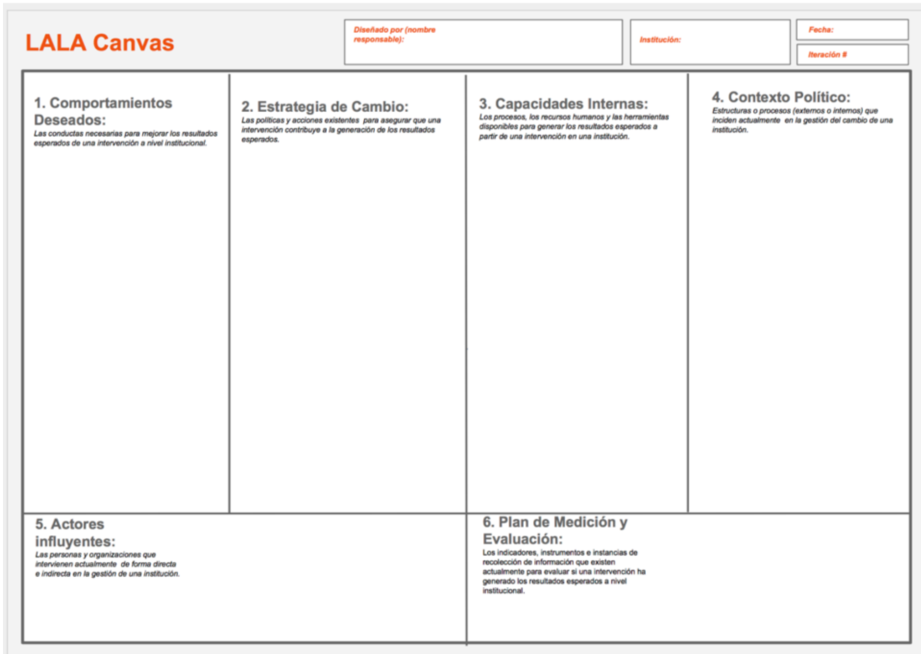


Figure 2-5 LALA Canvas template in Spanish. It includes all 6 dimensions to be discussed for analyzing what is the state of the institution regarding LA and what the expected status is after running the desired LA initiative or solution.

Activity: Application of LALA CANVAS

The LALA CANVAS is completed in groups of 3 to 5 people guided by a moderator. To ensure that the discussion allows a diagnosis to be made at the institutional level, it is recommended to use it on a convenience sample of at least three people from the institution which is the focus of the discussion. To enrich the discussion, you can incorporate learning analytics experts or stakeholders from other higher education institutions.

The procedure is as follows:

1. The moderator introduces the objective of applying the LALA CANVAS and briefly presents what each of the dimensions means.

2. Each group analyzes different dimensions. It is advisable to offer a limited time, between 10 and 15 minutes, to complete each dimension. Participants can add ideas in the canvas quadrant corresponding to the dimension analyzed using post-its. Ideally, the canvas can be printed in large format to facilitate discussion and exchange of ideas among group members. This process is repeated for each of the dimensions of the LALA CANVAS.

3. The moderator invites participants to discuss the main conclusions of each of the dimensions analyzed. If there is more than one group, each group can make a brief introduction of the conclusions of each dimension and reach a consensus. This activity can last between 10 to 15 minutes.

Evaluation and results

After applying the LALA Canvas, an analysis should be performed to detect the current status of the institution in terms of LA adoption, identifying desired behaviors and internal capacities to perform interventions. This qualitative analysis should be performed at the end of the activity with the participants of the discussion group and the moderator of the activity. The result will be used as a basis for the second phase of the manual and should specify at least: (1) the desired behaviors from the adoption of LA, (2) the current policies related to learning analytics; and (3) the key players.

2.3.3.2. Activity 2. Understanding the political context, institutional needs and expectations

Objective: To understand the political context and identify the key needs of the key actors according to phase 1), taking into consideration the current state of LA adoption, the desired state, and the main challenges.

Activity 2: Application of interviews to the main stakeholders (identified in phase 1). The minimum of stakeholders interviewed should be: institutional leaders, professors, and students.

- **Resources (Appendix A1.2):**
    - **Interview guidelines for each of the stakeholders (Appendix A1.2)**
    - **Consent form to inform the subjects of the conditions when participating in the study: Ensures the voluntariness of the participants in a process from whom private data is obtained, giving them the opportunity to be aware of the use that will be given to the information collected, as well as of its treatment.**
        - **Institutional leaders (Appendix A1.3)**
        - **Academic staff (Appendix A1.4)**
        - **Students (Appendix A1.5)**
- **Time for the activity: 30 minutes per personal interviews and 60 minutes per group interviews**

Resources: Interview Protocol

The interview protocol contains guidelines for interviewing the minimum of three stakeholders that should be considered at the institution that is the focus of analysis: authorities or institutional leaders, professors and students. This protocol addresses the six dimensions worked on in a group manner in the first phase of this manual based on the application of LALA CANVAS. The interview protocol, although based on those used in the SHEILA project, has been adapted to the reality of the Latin American context, trying to capture its particular idiosyncrasy.

Specifically, in the interviews, information will be collected on the main stakeholders' perception about:

- The current use of the institution's educational data (the data on students' and professors' performance that was collected and analyzed, administration and management of that data, actions that are made based on these data, existing analytical tools, technological infrastructure, policies on access and privacy).

- The expected use of the institution's educational data (the data about the students' and teachers' performance that should be collected, administration and management of this data, actions that should be carried out based on this data, analytical tools that should be incorporated into the institutional management, technological infrastructure required, and necessary access and privacy policies).

Activity: Conducting Interviews

The interview protocol is of a semi-structured nature, so it should only be used as a guide to collect information during the conversations held with the different stakeholders. The steps for conducting these interviews are:

1. Reviewing and adapting the protocols. In this phase you should review the protocols to identify words or questions that need to be changed based on the results found in Phase 1 of this manual.

2. Selecting the sample of key actors. The sample of each one of the actors is done in a different way. Below, we specified what would be the recommended steps to select the sample of the minimum of three stakeholders to consider:

- **Authorities and institutional leaders:** Adopt a snowball type sample design (Creswell 2012). This consists of scheduling conversations with an initial sample, and in each conversation the authority is asked to suggest someone to interview, leaving the number of interviews subject to the saturation of information – that point is reached when the interviews no longer report new data regarding the topic of conversation (Creswell 2012).
- **Professors and students:** It is proposed to adopt a stratified design that allows different academic units of the institution to be represented in each group conversation (Creswell 2012). It is suggested to organize at least two group interviews with professors and at least two with students, ideally with five participants in each instance.

3. Scheduling meetings for each of the actors. A schedule should be prepared to conduct the interviews, contemplating between half an hour and an hour per interview. It should be considered that interviews with authorities or institutional leaders should be individual, while those with professors and students should be in groups, with an approximate number of between 5 and 8 participants.

4. Conducting the interviews. Follow the protocol designed for the interviews. To record the information collected in the interviews, there should be: 1) a moderator who asks the protocol questions, and 2) a support person who takes notes of the main comments of the interviewees. There should also be a person in charge of recording the audio or video of the conversation, an action for which the written consent of the interviewees must be obtained.

IMPORTANT NOTE: Before conducting the interviews, the informed consent protocols must be signed by all participants. This document must be scanned and stored. Without this protocol, the data extracted from the interviews should not be used.

Evaluation and results

After conducting the interviews, a qualitative analysis should be performed. It is recommended to have this done by an expert in the collection and analysis of qualitative information. To analyze the information collected, a coding process must be used, in which a text is reduced to descriptions of categories and subcategories (Creswell 2012). In this case, the categories (and subcategories) are: 1) Status of Adoption of Learning Analytics (data collected from students and professors; actions based on the data; access, management and collection policies; ethics and privacy policies), 2) Desired state of adoption of Learning Analytics (data that should be subject to consent; expected use of the data for the benefit of professors or students; frequency with which the data is reported; comparative use of the data; visualization of the data) and 3) Challenge in Adopting Learning Analytics at institutional level. The comparison of the information of all the categories should facilitate the preparation of a report with a list of needs that could be covered with the design and/or adoption of an LA tool.

NOTE: We recommend using the coding scheme proposed in this document, since it captures all the aspects identified after collecting information from four Latin American institutions. However, the coding scheme could be adapted according to the institution's interests and needs.

2.3.3.3 Activity 3. Identifying expectations about the use of educational data

Phase 3 Objective: To get to know the expectations of students and professors about the collection and analysis of educational data of the institution in aspects related to ethics and data privacy.

Activity: Application of online questionnaires to professors and students.

- **Resources:**
    - **Questionnaires to be applied to professors (A1.4)**
    - **Questionnaires to be applied to students (A1.5)**
- **Time for the activity: Answering each questionnaire takes approximately 10 minutes (preparation and application can take between 1 and 3 months)**

Resources: Online questionnaire for professors and students

The purpose of the questionnaire is to measure the expectations of academic staff and students in different situations related to the use of educational data in higher education institutions with a focus on ethical aspects of data treatment. These questionnaires are based on the ones from the SHEILA project. Latin American region, different from Europe, does not have a shared regulation for ethical data treatment and each country manages this in a different way. These questionnaires are therefore biased towards the ethical data treatment in order to capture the particularities of each country in the region in this regard.

Each situation in the questionnaire is summarized in a statement: the professors' questionnaire consists of 16 statements, and the students' questionnaire of 12 statements. For each statement there are two Likert scales from 1 to 7: one scale measures normative expectations, and the other measures predictive expectations. The normative scale measures if what is described by the statement is something that the respondents would like to see happen in their institution, while the predictive measures if what is described by the statement is something that the respondents believe will happen in their institution (see Example 1).

Example 1: "The university will request my consent before using any personal data (for example, ethnicity, age or gender)."

Ideally, I would like it to happen								I think it can actually happen						
I disagree						I agree		I disagree						I agree
1	2	3	4	5	6	7		1	2	3	4	5	6	7

In addition to the statements and their respective Likert scales, the questionnaires have an informed consent section and another section of characterization, in which the participants must answer questions related to their gender, faculty where they are enrolled, nationality, and other aspects that are important to characterize the population of the institution.

Activity: Application of Online Questionnaires

The steps to apply the questionnaires are as follows:

1. Reviewing and adaptation of the questionnaires. In this phase, the proposed format for the questionnaires should be revised in order to identify words or questions that should be changed according to the language used in the institution.
2. Preparing the questionnaires in online format. After having adapted the questionnaires to the context of the institution, one questionnaire should be created for professors and one for students in a survey-developing web service, such as Google Forms, Surveymonkey or Qualtrics. These services have grid-like formats that facilitate the creation of Likert scales under a common statement.
3. Testing the online questionnaires. To avoid errors in the online application, the questionnaires should be tested by sending links to academics, professors and students of the institution as appropriate. Those who can review the questionnaires should answer the questions and notify if the options contemplate the possible response options, if there are errors in the text and corroborate the correct sending of the information to the server.
4. Applying the online questionnaires. The questionnaires are applied separately to professors and students. For both groups, the best option is to adopt a sample design of census character (i.e. survey all the members of the institution). However, if a census sample is not possible, stratified random designs can also be applied (i.e. a sample of different populations of different faculties). The invitation to answer the questionnaire is usually sent via email by an entity that coordinates the faculty and the student body, for example, a teaching and learning center in the case of professors, and an area of Student Affairs in the case of the student body.
5. Analysis of the questionnaires for the extraction of results. After applying the questionnaires, a quantitative analysis must be performed. First, the response rate must be estimated based on the sample, and then the percentage and number of answers with high levels of agreement perez(options 6 and 7) per statement. The answers must be organized in order from highest to

lowest percentage to determine in what situations professors and students have high expectations. Also, the difference between the percentages of the normative and predictive scale can be analyzed per statement, in order to determine situations in which professors and students have high expectations but do not expect them to be covered by the institution.

2.3.3.4. Activity 4. Developing change strategy

The Instrument: The LALA Template

The LALA Template consists of a template to document the desired status of a higher education institution from the adoption of a tool based on learning analytics. The template has the same six dimensions as the LALA Canvas: 1) Desired behaviors, 2) Change strategy, 3) Internal capacities, 4) Political context, 5) Influential actors, and 6) Measurement and evaluation plan. However, this template is completed based on what is expected to occur in the institution as the result of the adoption of an analytical tool, establishing strategic lines. The change strategy resulting from this activity, will include aspects such as establishing a plan of objectives for the institution, guidelines for involving key actors in the process, guidelines for generating a culture around LA in the institution, and training plans.

Activity – Application of the LALA Template

The template must be completed by a team of key people in the higher education institution that is the focus of the analysis. The members of the team can distribute the dimensions to complete them individually, or the team can meet and complete the template as a whole. There is no preset time to complete the document, but it is suggested to have at least one session to plan and/or perform the work, and another session to review what is described in each dimension (each session of one hour approx.).

To ensure that the discussion allows the development of a strategy focused on the needs of students, professors and authorities, it is recommended to have LALA Canvas and the results of interviews and questionnaires when filling out the LALA Template. To enrich the discussion, it is also possible to incorporate experts in learning analytics or actors from other higher education institutions.

LALA Template Analysis

After applying the questionnaires, a quantitative analysis must be performed. First, the response rate must be estimated based on the sample, and then the percentage and number of answers with high levels of agreement (options 6 and 7) per statement. The answers must be organized in order from highest to lowest percentage to determine in what situations professors and students have high expectations. Also, the difference between the percentages of the normative and predictive scale can be analyzed per statement, in order to determine situations in which professors and students have high expectations but do not expect them to be covered by the institution.

2.4- Technological dimension

In this section the technological dimension is presented (Figure 2-6). It describes its main objectives, its general vision, the methodology used to define it, and the work plan, including the description of the resources needed for its application and the expected results and evaluation.

The objective of the technological dimension of the LALA framework is to provide guidelines for designing, implementing or adapting, and evaluating a LA technological solution or process that wants to be intervened. In addition, a series of guidelines are incorporated in this dimension to ensure the adequate collection and administration of educational data, as well as the management of the adequate infrastructure and the technical capacities to support the technological solution.

This dimension will be conditioned by the decisions taken in the institutional and ethical dimensions, since both can condition the way in which the tool is implemented and designed.

The technical details on the steps to follow for the development and/or adaptation of a tool will be presented in the next chapter of the LALA handbook that will serve as a complement to this dimension.

2.4.1. Objective

The application of the dimension will answer the question: What steps do I need to follow to work on the design, implementation and/or adaptation and evaluation of a learning analytics tool or process that is adapted to the needs of the key stakeholders?

The key stakeholders are defined as in the Institutional dimension, but adding also the "Developers", therefore, the stakeholders for this dimension are: academic staff, students, managers and developers or technicians.

The expected main result is a list of design and implementation requirements that could be used for designing or adapting a LA tool, as well as a guideline for evaluating and testing this solution or process. More specifically, it will allow to:

- Identify key design requirements for the key stakeholders that should include the LA technology solution to meet the needs identified at the institutional level.
- Identify the technical considerations to be taken into account for the installation of a technological solution or process regarding the required hardware and software, the data sources to be considered for its installation, as well as the technical personnel necessary for its implementation and evaluation. This technological solution or process can be redesigned to be adapted from an existing one and must take into account the aspects of interoperability with the systems already implemented in the institution.

- Identify the steps to consider when designing a guideline for evaluation and testing of the technological solution or process to understand if it meets the needs required by the institution and its main stakeholders.

The main result for applying this dimension will be a list of requirements for the design and implementation or adaptation of the technological solution or process, as well as a set of guidelines for its evaluation and testing. The technical details on the steps to follow for the development and/or adaptation of a technological solution or process in accordance with these requirements will be presented in other deliverables of the project that will serve as a complement to this dimension.

2.4.2. Technological Dimension Manual: Overview

The dimension is composed of three main activities accompanied by a set of resources (Figure 2-6) (1) Definition of design requirements, in which the design requirements of the solution or process are defined; (2) Development and implementation and/or adaptation of the solution, in which the technical considerations for the development and implementation of the solution are identified; and (3) Evaluation and testing of the solution. Each activity, as well as the defined resources, were defined following a different methodology. Consecutively, it is detailed what steps were followed for creating the activities and resources.

It should be noted that the activities described in this dimension are generic for the implementation or adaptation of a technological solution. However, there may be cases in which the institutional reality allows defining the requirements of the tool in a more direct way, without the need to go through the indicated phases. In this case, it will not be necessary to follow the entire proposed process, and it will be possible to go directly to the implementation and/or adaptation process.

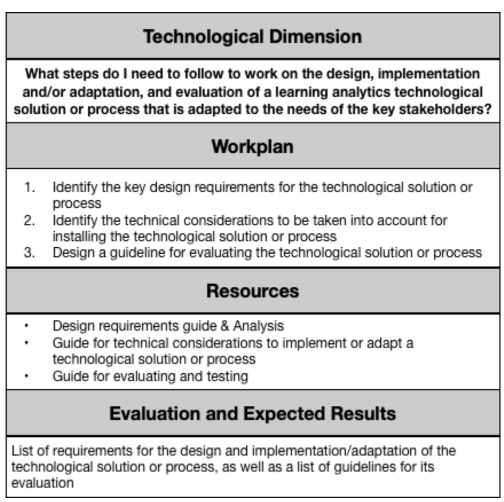


Figure 2-6 Technological dimension of the LALA Framework.

2.4.3. Methodology

2.4.3.1. Activity 1. Definition of requirements

For designing and developing or adapting a LA technological solution or process, we find different methodologies that guide us in the control and collection of requirements flow with the objective of keeping in mind each of the participating profiles and stakeholders who influence and impact the process.

For the definition of requirements, we took as the reference the OrLA framework, OrLA being the acronym of Orchestration of Learning proposed by Prieto et al. (2018). The OrLA framework is proposed as a tool to promote the adoption of LA tools in learning experiences and teaching practices. Specifically, OrLA supports the communication processes from a simple conceptual vision among the three actors that mainly intervene in the process of design, implementation and adoption of learning analytics tools: (1) the "Teacher", who happens to be the main client of this process, since he requests the support in LA techniques to be applied in the classroom; (2) the "Researcher", who performs a conceptual analysis of possible solutions that meet the requirements; and (3) the "Developer", who collects this background information and translates it into a physical tool that allows to perform and fulfill the purpose for which the tool was designed and implemented.

To facilitate communication among the different actors, OrLA defines 3 forms, one for each of the actors. Each form consists of a series of guiding questions that encourage the reflection of each of the actors separately on the design of the tool and its use, as well as the cross-discussion among the actors.

Even though OrLA was designed to support communication among the actors for the adoption of LA tools, it can also be taken as a support tool for the design of other tools. This is the case in the LALA project, where we take as a reference the framework as a tool to design a learning analytics tool where all the actors involved in the process are considered. Specifically, we adopted OrLA's idea of using forms as a communication mechanism among the actors, but in this case, we use them as a guide to define and extract the design requirements for a learning analytics tool. In addition, we propose an extension of OrLA to include a new stakeholder that we call Manager. In the LALA project we have observed that a common profile that interacts with learning analytics tools is the manager, in charge of performing institutional processes for decision-making at the institutional level. Although managers can play different roles, we observed that it is important to consider this role in the design/adaptation of the technological solution or process, since it might impact lots of aspects of the organizational processes.

Therefore, the technical manual of LALA in its requirements defining phase, will have a guide composed of a set of forms based on the OrLA model, one for each of the actors: (1) the "Teacher" and/or "Manager", who happens to be the main client of this process, since he requests support in learning analytics techniques to be applied in the classroom; (2) the "Researcher", who performs a conceptual analysis of possible solutions that meet the requirements; and (3) the "Developer", who collects this background information and puts it into a physical tool that allows to perform and fulfill the purpose for which the tool was designed and implemented. In the case of not having one of the actors described above, it is recommended to consult a third party external to the project.

2.4.3.2. Activity 2. Technical considerations

The Technical Considerations guide aims to inform the stakeholders involved in the process of designing or adapting the technological solution or process about technical considerations to take into account. In this guide we analyze the technical requirements from 4 dimensions:

(1) the required hardware, the objective of this dimension is to analyze what equipment is required for the implementation of the tool;

(2) required software, the objective of this dimension is to analyze what software is required for the implementation of the tool;

(3) technical personnel, the objective of this dimension is to analyze what skills should the technical personnel responsible for the implementation and administration of the tool have; and

(4) data sources, the objective of this dimension is to analyze information about the data used by the tool.

This guide was created taking as a reference the results presented in different systematic literature reviews, which analyze tools aimed at the LA (Bodily & Verbert, 2017, Schwendimann et al., 2017, Jivet et al., 2018, Jivet et al. al., 2017; Verbert et al., 2014). Although the literature reviews considered do not focus on the implementation and technical requirements of the analyzed tools, they provide an overview of what kind of tools have been developed, what their characteristics are, what type of actors are targeted, what are the data sources that the tools use, with which learning platforms they interact, and what is the students' perception of the tool. For example, Schwendimann et al. (2017) identify 6 types of sources used in interactive dashboards to obtain data: (1) use of log to track user activity, (2) learning materials used or produced by the user, (3) information obtained directly from the users for analytical purposes (including interviews and questionnaires), (4) institutional register of databases, (5) user's physical activity (tracked with physical sensors), and (6) external APIs (external platforms data collection). These classifications were considered in the dimension "Data Sources".

In addition, the relevant considerations and suggestions to be taken into account in the design of the tools were taken from the reviews. For example, Bodily & Verbert (2017) suggest a series of questions to be asked for the implementation and reporting of tool results, one question is "What types of data support your goal?". These questions were considered when building the "Data Sources" dimension and the "required software" dimension.

2.4.3.3. Activity 3. Evaluation

The guide on considerations for the evaluation and testing aims to create awareness about the considerations to take into account for the creation of a guideline for the evaluation and testing of the learning analytics tool designed in the previous phases. The guide is composed of a list of verification items that permit to verify if the most relevant variables are being considered to evaluate and test the tool.

The considerations for the evaluation and testing guide were created taking as a reference the results presented in different systematic literature reviews, which analyze tools aimed at the learning analytic (Bodily & Verbert, 2017, Schwendimann et al., 2017, Jivet et al. al., 2018; Jivet et al., 2017; Verbert et al., 2014; Verbert et al., 2013). These literature reviews indicate that most tools' evaluation focus on analyzing the usability and usefulness of the tools. In addition, they suggest performing tests that allow evaluating the impact of the tool on the stakeholders or actors involved. For example, Jivet et al. (2018) recommend that: "The assessment of the dashboards should focus, firstly, on whether the objectives established in the design phase are met, secondly on the impact they have in terms of motivation and finally on usability".

From these literatures reviews we took into consideration different aspects to be considered for designing the evaluation guideline or plan:

1. The participants to be considered in the evaluation. According to the literature reviews, the participants of the evaluation have to be those who participated in the requirement extraction phase.

2. The evaluation should include a usability test for evaluating how the stakeholders "understand the tool".

3. The guidelines should include usage tests for evaluating whether the solution meets the requirements defined in the requirement phase from all stakeholders perspectives.

2.4.4 Workplan

The application of the technological dimension is done in three different activities. Table 2-2 summarizes the different activities, the resources used in each activity and its nature.

Activity	Resource	Technical dimension	Instrument Type	Application
1. Requirements definition	Guide for the definition of LALA design requirements	• Professor • Manager • Investigator • Developer	Qualitative/ Group	In person
2. Tool development and implementation	Technical considerations guide for the development and implementation of the tool.	• Data sources • Required *hardware* • Required *software* • Technical staff	Qualitative/ Group	In person/ Online
3. Tool evaluation and testing	Considerations guide for the design of the tool evaluation and testing procedure	• Types of evaluations • Required resources • Participants • Importance of the pilot • Ethical dimension	Quantitative/ Group	In person/ Online

***Table 2-2* Technological manual phases, with their corresponding dimensions and instruments used, specifying their nature and application**

2.4.4.1. Activity 1. Requirements Definition

The resource: Guide for the extraction of Requirements for the design of LA tools

Objective: To identify the key design requirements by institutional leaders or managers, researchers and academic staff that should include the learning analytics technology solution to cover the needs identified at the institutional level. Activity 1: Application of the guide for the extraction of requirements for an LA tool. ● **Requirements Extraction Guide for a learning analytics tool (Appendix A2.1)** ● **Time for the activity: 3 hours**

The resource "Guide for the extraction of requirements for the design of learning analytics tools" consists of a series of forms for each of the stakeholders involved in the process (Academic staff, Managers, Researchers and Developers). Each form is composed of a series of questions that make the different actors reflect upon 6 main aspects of the use and adoption that the tool in the process of being designed would potentially have: (1) local limitations and challenges related to the tool; (2) the current practice that is developed without using the tool in the process of being designed; (3) how the current practice would vary the inclusion and use of the learning analytics tool in the process of being designed; (4) the characteristics of the innovation that the use of the learning analytics tool in the process of being designed would incorporate; (5) ethical and privacy issues to consider and (6) a set of cross-questions among the different actors to jointly assess and decide on the characteristics of the learning analytics tool in the process of being designed and its potential adoption.

1. **Form for Academic staff.** The form for the Academic staff is structured in 4 sections; The first section is to define the context of the tool and the beginning of the discussion with the rest of the profiles of the process. For this, 5 general questions must be answered plus a brief description of the educational context. In the second section, the professor must complete a matrix associated with the activities developed by the professor and how they are carried out in the classroom. For this, 4 dimensions are used within the matrix associated with the teaching activities and 4 dimensions associated with the way to perform these activities. In the third section the professor must recognize some restrictions, problems, challenges and difficulties in performing their defined and planned processes. For this it is necessary to answer 4 general questions within this context. Finally, a fourth section is completed in which ethical aspects are included. For this, the professor will have to answer 3 questions related to the use of the data, the access to them and the way they are collected.

   This form includes a general comment section for the researcher and the developer, who will request or complement information on the tool's requirements based on the academic staff' answers.

2. **Form for Managers.** The manager must define the educational control context to be visualized in administrative terms to control and suggest improvements in the educational process. The form for the manager is structured in 4 sections. The first section aims to define the context of the tool and

the complement of the discussion initiated by the professor with the rest of the profiles of the process. For this, 4 general questions must be answered plus a brief description of the educational control context. In the second section, a matrix associated with the activities developed by the manager and how they are performed in the capacity of administrator must be completed. In the third section a series of questions are asked to help the manager to recognize the restrictions and problems that could be found in the activities defined above. The fourth section includes 3 questions in relation to the ethical aspects of the use of data.

The Manager profile also includes a section to provide general comments by the Professor, the Researcher and the Developer that complement or request more information from the Manager.

3. **Form for researchers.** The researcher must define which is the most innovative part of the tool that is being designed, identifying the aspects that make it different from existing tools. Their form is structured in 5 sections. The first section defines the context in which the tool would be applied. For this, 4 general questions must be answered plus a brief description and a fifth one that asks what aspects will be considered to evaluate or measure the benefits of innovation. In the second section the researcher completes pre-requisites for each one of the actors who will use the tool (academic staff-students-managers) considering the data analysis and the preconceived beliefs by each actor. The third section includes questions to understand what the main activities of the actors involved are and how they could be improved with the tool. The fourth section includes general questions on aspects of motivation for the use of the tool by the professor or manager, as well as the support that could be obtained from the use of the tool, and the measuring of impact and success of the designed solution. Finally, the fifth area is included to consider the ethical and privacy aspects.

   This form also includes a comments section that will be completed by the developer and the professor or manager to complement or request more information about the researcher's answers.

4. **Form for developers.** The developer must identify the aspects related to the development implications that the implementation of the tool entails. The form for the developer is structured in 5 sections. In the first section, the purpose and benefits of the tool are defined. In the second section a matrix is completed regarding the activities that the academic staff and/or managers would develop with the support of the tool in the process of being designed. In a third section, the developer reflects on some questions that help him to recognize alternative tools that could complement the proposed innovation or technological solution. In the fourth section, questions related to the ethical and privacy aspects are included.

   The Developer profile also includes a comments section that will be completed by the researcher and the professor or manager in order to complement or request more information on the questions developed.

Activity: Application of the Requirements Extraction guide

For the application of this instrument, it is necessary to have a group of at least three participants with a profile that corresponds to one of the three actors that interact: one with a professor and/or manager profile, another with a research profile and another with a developer profile.

The application of the guide will be performed in one or several sessions that can be performed by all the actors involved in the design of the tool in a synchronous or asynchronous manner. In both cases, the activity will start by asking the participants of the design group to complete the form corresponding to their profile. Once completed, the discussion session among actors will begin. In case the discussion is performed asynchronously, they will comment on the form of their colleagues. If it is done in a synchronous manner, the discussion among the different actors can take place in person.

It is recommended to organize the activity in three hours: the first hour when the actors complete their forms individually and the following two hours to discuss the different solutions, ensuring the exchange among the different actors involved. The objective of this activity is to promote communication among the main actors in order to define the requirements of a tool that can be designed in the LA context, consequently the activity can be shortened or extended depending on the results obtained.

Analysis of activity results

Once the forms have been completed, the researcher or tool development project leader should review the completed forms in order to:

1. Extract separately the requirements specified by each of the stakeholders involved in the project.
2. Identify what requirements coincide among the different stakeholders and ensure that all the minimum requirements are considered in the design of the tool.
3. Identify the type of data that each of the stakeholders manages to ensure that they will be considered part of the database of the tool to be designed.
4. Make a list of minimum requirements organized in order of priority.

2.4.4.2. Activity 2. Development and implementation

Objective: To identify the technical considerations to be considered for the installation of a learning analytics solution or process from the point of view of the required hardware and software, the data sources to be considered for its installation, as well as the technical personnel necessary for its implementation and evaluation. Activity: The development and implementation team answers the questions planned in the instrument *Guide of technical considerations for the development and implementation of the tool*. ● **Resources** o **Guide of technical considerations for the development and implementation/adaptation of the tool (Appendix A2.2)** ● **Time for the activity: 4 days, each for each dimension**

Resources: Guide of technical considerations for the development and implementation of the tool.

The technical considerations guide is composed of a set of 25 open questions. The guide contains 4 initial questions to identify the sources of information available for the tool. In addition, a set of questions were created for each of the dimensions to be considered: 9 questions for the *Data Sources* dimension; 5 questions for the *required Hardware* dimension; 5 questions for the *required Software* dimension and 2 questions for the *Technical personnel* dimension. The guide collects information on the types of data and data sources used by the tool, which hardware and software equipment are required for the operation of the tool, as well as the technical personnel required for the implementation and maintenance of the tool. Below, we detail the objective of the questions in each of the aspects:

1. **Data sources.** The questions included in this aspect are aimed at the development and implementation team analyzing factors that affect this phase, such as: what data the tool requires, where that data comes from, who the responsible for the administration of the required data is, and what procedure is required to access the data, what the characteristics of this data are and what data model it uses, where the data required by the tool should be stored, what the process of integrating the data with the tool is, what the process to manipulate the data is, who the person or people in charge of data management will be and finally, who will have access to this data.

2. **Required hardware.** The questions included in this aspect are aimed at the development and implementation team for them to analyze factors that affect this phase, such as: the type of equipment that is required to install the tool (workstations, servers, routers…), as well as the specifications that the required equipment must have; what kind of physical space the equipment requires; what additional equipment is required for the operation of the tool such as tablets, microphones, cameras, etc.; what equipment is required to maintain and manage the technological solution or process.

3. **Required software.** The questions included in this aspect are aimed at the development and implementation team, for them to analyze factors that affect this phase, such as: the programming language in which the tool is developed, what version of the language and libraries should be configured, what operating system the tool operates on, what database management system the tool uses, what other applications the tool requires to operate (dependencies) and finally, what type of licensing the tool requires.

4. Technical personnel. The dimension of the technical personnel is considered as the last aspect to be considered. The questions for this dimension must be answered once the answers of the previous dimensions are clear, in this way the required characteristics of the technical personnel are clear. The questions included in this dimension are aimed at the development and implementation team, for them to analyze factors that affect this phase, such as: what knowledge the technical personnel will need to have to perform the installation and configuration of the tool; and what knowledge is required for the personnel that will be in charge of the administration and maintenance of the tool.

Activity - Requirements guide application

The technical considerations guide must be completed by the team in charge of the development and implementation of the tool. It is recommended that in this team should participate at least one member of the team that leads the project that promotes the incorporation of learning analytics tools in the institution.

To complete the guide, the team must answer the sequence of questions included in the guide. It is recommended to follow the sequence of questions and to answer each of them considering the requirements of and information about the tool that is to be implemented. To answer all the questions the team needs to analyze the tool in detail, as well as to investigate and consult sources external to the team to obtain the information required to answer. To complete the guide, several work sessions may be required. In the first session, all the questions that the team can answer are completed and for the questions that cannot be completed in the first session people should be assigned to obtain the information. In the second session, the information obtained is analyzed for the questions that were not answered in the first session and the answers are formulated. The procedure can be repeated until all the questions in the guide are completed. The questions can be adjusted to any type of tool that is to be implemented, so all questions should be answered.

The answers to the questions must be clear and specific to facilitate their interpretation. For example, for the following question:

> *What data does the tool to be implemented need?*

An answer could be:

> *The tool requires data on: (1) personal information of the students (age, gender, full name, ID number, address); (2) grades obtained in the evaluations; and (3) evaluations proposed in the course.*

Activity results

Once all the questions in the guide have been answered, an analysis must be performed to detect possible problems that may arise during the tool development or implementation process. For example, if the results show that additional equipment is required to implement (webcams, tablets, microphones, etc.), the team should evaluate the aspects such as: what the process that establishes the institution for the acquisition of that equipment is, whether the project has the budget for the purchase of the equipment, in how much time the equipment can be acquired, among others. For each question, the team must make an evaluation of the given response and what processes or activities arise from the response: for example, requesting the permission for access to the data, hiring technical personnel, equipment acquisition, generating agreements with external entities, conditioning of the areas, among others.

2.4.4.3. Activity 3. Evaluation considerations

Objectives: To identify the steps to consider when designing a guideline for evaluating the technological solution or process to understand if it meets the needs required by the institution and its main stakeholders. Activity: Developing an evaluation plan. Resources o **Guide of considerations for the design of the procedure for evaluation and testing of the tool (Appendix A2.3).** ● **Time for activity: 15 minutes**

The instrument: Evaluation plan

The guide of considerations for the design of the procedure of evaluation and testing of the tool is a revision list that serves as a guideline to verify what elements should be considered to perform the evaluation of the tool. The guide does not explain how to plan and perform the evaluations, since each evaluation of a technological solution or process is very particular. This guide is composed of 5 sections that are detailed below:

1. **Types of evaluations.** This section allows us to analyze whether the designed evaluation process takes into account the aspects that should be considered when evaluating a LA technological solution or process. These aspects are: (1) usability, which allows us to detect errors and understand the ease of use of the tool by stakeholders; (2) utility, which allows us to know the stakeholders' perception of the information presented and the functionalities of the tool; (3) system check, which allow us to understand the performance and response times of the tool; (4) adoption, which allow us to understand how *stakeholders* or main actors interact with the tool; and (5) impact, which allow us to evaluate if the tool has an effect on the established improvements related to learning.
2. **Required resources.** This section allows analyzing whether the evaluation plan has considered all the resources needed to run the evaluation: duration time, personnel, economic resources, measurement instruments, instruments for the data collection and the data sources required for the tests.
3. **Participants.** This section allows analyzing if the defined evaluation plan is considering all the stakeholders who will use the technological solution or process.
4. **Importance of the pilot.** This section allows analyzing the relevance of the evaluation plan. That is, if the main objective of the tool is being evaluated in the evaluation plan. For example, if the objective of the tool is to improve students' learning, it is necessary to be sure that our pilot tests provide us with results that allow us to measure the improvement in learning, and not to remain in usability and utility tests.
5. **Ethical consideration.** This section allows verifying whether the ethical aspects for the data collection, administration and storage in the technological solution or process are being considered. The institutional dimension details the ethical considerations and informed consent that must be considered before starting the evaluation and testing of the tool.

Activity- Application of the evaluation plan

Once the evaluation plan has been defined, a member of the team involved in the technological solution or process implementation or adaptation has to apply it and lead the process. Usually, a member of the team involved in the development of the solution has a better understanding of the objectives defined for the tool at the end-user level.

The plan must be delivered to the team in charge of the tool implementation, who have greater knowledge of the tests that will be performed. The members of the implementation team, as a group, complete a file marking each of the items that were considered in the tests. Subsequently, the member of the team that leads the initiative asks the same questions to the technical team but is responsible for marking the item as verified. In addition, in each item the team member who leads the initiative must ask how each item is being considered in the evaluation tests, in order to verify if the implementation team has clarity of the meaning of each item.

If the results of the two plans are different, a third plan should be completed among the implementation team and the member of the team in charge of the project. To complete the third plan, there must be a consensus among all the participants to verify or not an item. If two plans are the same, either one is considered for analysis.

Analysis of the activity results

At the end of this activity we obtain a checklist with the items that have been considered in the evaluation tests and those that have not yet been considered. The implementation group must analyze each of the items that have not been included in the tests and define a strategy for them to be considered. For example, if the impact tests have not been considered, an evaluation should be defined that measures the impact of the tool, and the instruments and resources necessary to perform the test.

2.5- Ethical Dimension

In this section, the ethical dimension manual is presented (Figure 2-7). It describes its general vision, its objectives, the methodology used to define it, and the work plan for applying it, including the description of the resources needed for its application and the expected results and evaluation.

Ethical Dimension
What are the ethical and privacy considerations that the institution should take into account in order to adopt Learning Analytics solutions and policies?
Workplan
1. Review the literature and national and international regulations on data management 2. Anticipate academic staff and students expectations 3. Adapt considerations according to the literature, regulations and expectations
Resources
• Ethical manual • Interview protocols from the 2nd activity of the Institutional Dimension • Academic staff and students serves from the 3rd activity of the Institutional Dimension
Evaluation and Expected Results
Current status of the institution in relation to the ethical treatment of data and considerations for promoting institutional adoption of a Learning Analytics initiative

Figure 2-7 Ethical Dimension Manual in the LALA framework

2.5.1. Ethical Dimension: Overview

The ethical dimension of the LALA framework aims to promote the adoption of ethical and privacy considerations in the design and implementation of learning analytics tools. Specifically, it describes considerations that have been documented in the literature on LA to guide the management of educational data in higher education institutions, referencing regulations that affect the protection of personal data at the local and international level.

This dimension is related to the institutional dimension, where the current status of the institution regarding LA is described. Also, the results of this manual can lead to some considerations to be taken into account in the Technological dimension.

2.5.2. Objective

The application of the dimension will answer the question: *What are the ethical and privacy considerations that the institution should take into account in order to adopt or implement a learning analytics tool?* Those who review this manual will be able to:

- Learn about ethical and privacy considerations that have been described in the literature and in national and international regulations for the responsible adoption of learning analytics tools.
- Anticipate the ethical and privacy considerations necessary for the design and implementation of an analytics tool at an institutional level.

From the review of this dimension, the main actors of a higher education institution will be able to define a strategy to adapt ethical and privacy considerations described in the literature, and thus ensure the responsible adoption of learning analytics tools in their institution.

2.5.3. Methodology

This manual was created in three stages. In a first stage, a systematic review was made in Google Scholar, looking for articles that address privacy and LA issues between 2014 and 2018, which is when a boom is identified in LA area publications. The search terms were "Learning Analytics" and "Ethics". In a second stage, 3 experts participated in the selection of those articles whose objective was to provide ethical and privacy considerations to guide the responsible adoption of LA. Finally, in a third stage, a selection was made of those articles whose main focus was the socialization of ethical considerations. From this search, 4 articles or reports containing information on the most relevant ethical considerations were selected: JISC (2015), Draschler & Greller (2016), Pardo & Siemens (2014), and Steiner, Kickmeier-Rust & Albert (2016).

Apart from the ethical considerations identified from the articles considered in the literature review, we propose a set of guidelines for anticipating academic staff and students expectations regarding the ethical aspects of LA and how to approach them for proposing and adapting their own solution. Finally, each institution should propose their own regulation, adapted to their context and situation.

Please, note that the regulations referenced in these 4 articles were used, but these regulations do not necessarily apply to the Latin American context. However, the application of this dimension should contemplate a revision of regulations at the regional level.

2.5.4. Work plan

The application of the ethical dimension involves three sequential activities (Figure 2-8): (1) review the literature and regulations on ethical and privacy considerations in the design and implementation of learning analytics, (2) anticipate ethical and privacy considerations for the design and implementation of an learning analytics tool at the institutional level (using phases 2 and 3 of the institutional manual), and (3) define a strategy to adapt considerations in the literature and in national and international regulations to the institutional context. This dimension mainly covers the first activity, but the second activity can be approached using the instruments proposed in the institutional dimension to identify professors' and students' expectations in relation to data ethics with Learning Analytics technological solutions or processes.

The main stakeholders involved in the work plan for applying this dimension are those identified during the Institutional Dimension, which usually involve: academic staff, managers, and students. In this dimension, it will be also useful to consider including in the discussion someone representing the technical personnel from the institution, in charge of treating the institutional data.

Ethical Dimension
What are the ethical and privacy considerations that the institution should take into account in order to adopt Learning Analytics solutions and policies?
Workplan
1. Review the literature and national and international regulations on data management 2. Anticipate academic staff and students expectations 3. Adapt considerations according to the literature, regulations and expectations
Resources
• Ethical manual • Interview protocols from the 2nd activity of the Institutional Dimension • Academic staff and students serves from the 3rd activity of the Institutional Dimension
Evaluation and Expected Results
Current status of the institution in relation to the ethical treatment of data and considerations for promoting institutional adoption of a Learning Analytics initiative

Figure 2-8 Work plan activities of the ethical dimension, resources and expected results

2.5.4.1. Activity 1. Review the literature and national and international regulations

Objective: To identify existing national and international regulations regarding privacy and ethics in the use of personal data and identify the main needs to be considered in relation to data.

Activity 1: Reviewing the summary of the articles considered to obtain an overview of ethical considerations at the international level.

- **Resources**
    - **Documents and articles related to the data treatment and use for Learning Analytics.**
- **Time for the activity: 1 h.**

The instruments: Regulations Summary Document

The Regulations Summary Document contains a summary of the four selected articles (Table 2-3) based on the manual methodology, and the proposed considerations to address ethical and privacy aspects in the design and implementation of strategies based on indicated learning analytics. In the following sections each of the articles is detailed, describing the proposed considerations in greater detail.

Authors	Year	Title/Journal	Proposed considerations
JISC	2015	*Code of practice for learning analytics (A3.1.1)*	• Responsibility • Transparency and consent • Privacy • Validity • Access • Facilitate positive interventions • Minimize adverse impacts • Administration
Draschler & Greller	2016	*Privacy and Learning Analytics - it's a DELICATE issue (A3.1.2)*	• Determination • Explanation • Legitimacy • Involvement • Consent • Anonymity • Technology • External
Pardo & Siemens	2014	*Ethical and privacy principles for learning analytics (A3.1.3)*	• Transparency • Students' control over data • Access rights • Accountability and measurement
Steiner, Kickmeier-Rust & Albert	2016	*LEA in Private: A Privacy and Data Protection Framework for a* *Learning Analytics Toolbox (A3.1.4)*	• Data privacy • Data purpose and ownership • Consent • Transparency and trust • Access and control • Accountability and measurement • Data quality • Data management and security

Table 2-3 Articles that propose ethical and privacy considerations for the design and implementation of strategies based on learning analytics.

Activity - Familiarization with national and international regulations

Stakeholders related to the implementation/adoption of the learning analytics tool should review the tools provided to propose an ethical guide for the use of data in their institution. This guide should be discussed with the members of the team participating in the initiative in order to verify that all the criteria are considered at all levels of the process of creation/adoption and implementation of the tool.

It is recommended to take the DELICATE Checklist (A3.1.2) as a reference to verify that the most relevant aspects are being considered in relation to the ethical treatment of the data. The DELICATE Checklist is a translation of the list of considerations proposed by Drachsler & Greller (2016). This document was created from a comprehensive review of international and European frameworks regarding the use of data for learning analytics. DELICATE consists of 8 action points that should be considered by the different stakeholders involved in the process of implementing and/or adopting Learning Analytics tools. This checklist might serve as a reference for those institutions that do not have any regional or national framework to start working with.

Result - National and international references to be considered for the creation of an institutional ethics instrument

The result of this activity is to educate and raise awareness among the stakeholders involved in the learning analytics project about the existence of national and international frameworks and references regarding data processing.

Activity results analysis

At the end of this activity a list of the current status of the institution in relation to the ethical treatment of data is obtained.

2.5.4.2. Activity 2. Anticipating teachers' and students' expectations in relation to data processing

Objective: To anticipate professors' and students' expectations in relation to data processing.

Activity 2: Reviewing the data collected in phases 2 and 3 of the institutional manual, which includes interviews and focus groups with students and professors which deal with aspects related to data processing.

- **Resources**
  - **Instruments related to phases 2 and 3 of the institutional manual of the LALA framework.**
- **Time for the activity: -**

Resources

The resources that will be used as a reference in this activity are the same as those used in activities 2 and 3 of the institutional manual of the LALA framework presented in this document.

Activity - Collecting information on the current status of academic staff and students' expectations in relation to data processing

Perform interviews and focus groups with reference to the instruments and indications of activities 2 and 3 of the institutional manual. In case the institution is considering only the Ethical dimension of the LALA framework, we suggest reviewing and applying the questionnaires of activities 2 and 3 of the Institutional dimension. These questionnaires are meant to collect data about the academic staff and students' perceptions about data management in their institution. If the institution has already applied the above mentioned questionnaires of the Institutional Dimension, we suggest revisiting the main conclusions extracted from their analysis.

Analysis and results - Determining current status on academic staff and students' expectations in relation to data processing

The result of this activity is to obtain a realistic view of the current state of the institution in relation to academic staff and students' expectations regarding ethics and data privacy. This result will be obtained from the review of the systematic analysis performed in phases 2 and 3 of the institutional manual.

At the end of this activity there will be a list of academic staff and students' expectations in relation with the ethics and data privacy regarding the data analytics project.

Objective: To create an institutional framework on ethics and data privacy for learning analytics, as well as the key instruments to ensure their proper use and treatment. Activity 3: Proposing a framework taking as reference the analyzes in activities 1 and 2 and creating forms to ensure the proper use and treatment of data at the institutional level. ● **Resources** ○ **Sample forms to ensure good treatment and use of data at the institutional level (A3.1, A3.2, A3.3, A3.4, A3.5)** ○ **Contract for institutional data use and sharing (A3.6)** ● **Time for the activity: -**

2.5.4.3. Activity 3. Adapting ethical and privacy considerations for the creation of the institutional framework on ethics and data privacy

Resources. To ensure good treatment and use of data at an ethical and privacy level, many institutions have forms that both students and professors must complete. These instruments serve to ensure that the institution has the informed consent of the participants in the institutional projects related to data, whether or not directly related to the learning analytics project. In addition, we provide an example of the type of contract needed in case of sharing some data with other institutions. In any case, these are only some templates that might be useful in some contexts, but depending on the context you might need to adapt them or use additional ones.

In the LALA project framework, the institutions involved have generated documents for the management of some of the ethical considerations highlighted in the articles and reports summarized in the previous sections (Table 2-4). In Appendix A3.1-A3.5. of this document some examples of these instruments are included: informed consent forms for interviews and informed consent forms for questionnaires and sharing data contract with third parties.

Table 2-4 Examples of informed consents generated within the LALA project.

Type	Instrument and Description
Informed consent forms for interviews	Informed Consent: Ensures the voluntariness of the participants in a process from which private data is obtained, providing them with the opportunity to be aware of the use that will be given to the information collected, as well as of its treatment. Link to the consents used by the Pontificia Universidad Católica de Chile: ● **Institutional Leaders (Appendix A3.1)** ● **Academic staff (Appendix A3.2)** ● **Students (Appendix A3.3)**
Informed consent forms for questionnaires	Since the signature of participants/students/users cannot be collected in online questionnaires, consent statements are used through which the participant receives a description that clarifies the purpose and use of the information collected, as well as their willingness to participate. Then, the participant has the option to mark to confirm that he/she has reviewed said description. Link to the consents used by the Pontificia Universidad Católica de Chile: ● **Academic staff (Appendix A3.4)** ● **Students (Appendix A3.5)**
Contract Data Sharing with third parties	Example of the type of contract that could be made in case the institutions wants to share some data with a third-party. ● **Sharing data contract (Appendix A3.6)**

Activity - Reviewing and adapting the sample forms

Propose a manual for the ethical and private treatment of data at the institutional level, in accordance with the national regulations of the institution's country on the treatment of data.

Reviewing and adapting the forms provided as an example or creating new ones. It is important to remember that the forms must be adapted according to the internal regulations of the institution and validated by the ethics committee to ensure their validity. In addition, it is recommended for the institutions to have a data administrator to ensure that the forms are digitized and stored for recovery if necessary.

Result - Ethical manual and forms for data use and processing

The result of this activity will be an institutional manual on the ethical and private treatment of data validated by the governing bodies of the institution, as well as a set of forms to ensure the proper use and treatment of data.

2.6- Community dimension

In this section the community dimension is presented (Figure 2-9). It describes its general vision, its objectives, the methodology used to define it, and the main activities of the community and resources that have been generated for its dynamization.

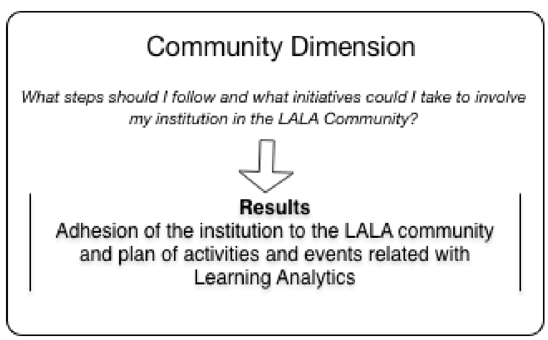


Figure 2-9 Communal Dimension of the LALA framework

2.6.1. Objective

The community dimension provides the guidelines for the creation of LALA community that promotes the exchange of results and experiences with other higher education institutions, favoring collaboration without compromising internal information and promoting a research and development community regarding the area of the learning analytics in the region.

The application of the manual will answer the question: *What steps should I and what initiatives could I take to involve my institution in the LALA community?* More specifically, the application of this manual will allows to:

- Adhere an institution and/or researchers to the Latin American learning analytics community - LALA.
- Define the degree of institutional participation and active or passive involvement within the community
- Access a collaboration network among the researchers from the LALA community, with other agents such as companies, public and private educational institutions and with other Latin American and international collaboration networks that will help identify potential partners for the preparation and presentation of joint research projects with a greater scope and impact.
- Disseminate initiatives related to Learning Analytics at a Latin American scale and establish contact with European or American institutions or networks.
- Promote research and the exchange of knowledge through conferences already established as the CLEI - Latin American Computation Conference - or the LACLO - Latin American Conference on Learning Technologies - to develop local capacity in HEIs in Latin America to create, adapt, implement and adopt Data Analytics tools to improve academic decision-making processes.

The result of the application of this dimension will mean that the institution joining the LALA community (and therefore the researchers associated with the institution) will have access to a series of benefits that will allow them to promote long-term sustainable cooperation, creating lasting relationships among its members, who contribute to the replication of the results obtained by the LALA project. All of the above will permit responding to the new challenges of the digital society that emerge from the incorporation of ICTs in education.

2.6.2. Community Dimension: Overview

Learning Analytics (LA) has been widely developed in the Anglo-Saxon countries, with the USA, the United Kingdom, Canada and Australia being the main contributors to this field. Their contributions in the area have been presented at the most important conference that is the Learning Analytics & Knowledge Conference - LAK, which has been organized since 2011.

In Latin America, although measuring and optimizing teaching and learning processes through LA has begun; the existing attempts in this direction are very isolated given the lack of a regional community that encourages the exchange of ideas, methodologies, tools and local results in the field. This is evident from a recent review of the literature developed by Dos Santos et al. (2017), where the little contribution made by means of scientific articles written by Latin American researchers to the LAK conference is established.

The first contribution registered by Latin American researchers to the LAK Conference was made in 2011. As of that date, 3 contributions have been registered in 2013, 6 contributions in 2014, 18 contributions in 2015 and only 2 contributions in 2016. All the contributions were written in English which gives little visibility of the work done for the Latin American community. On the other hand, from a questionnaire that was disseminated through email lists, social and academic networks in 2016, it was possible to gather information on about 28 research groups working in the LA area, identifying 20 groups in Brazil, 5 in Colombia and 1 group in Chile, Mexico and Paraguay respectively.

Currently, in Latin America there are two important conferences that attract the attention of researchers from Latin America, these are: 1) CLEI - Conference on Latin American Computing and 2) LACLO - Latin American Conference on Learning Technologies. The first does not currently have a line on learning analytics in Spanish and the second one included for the first time in 2017 a line on learning analytics in Spanish. These two conferences will be organized jointly for the first time in 2018, which provides an ideal setting to gather researchers, professors and students interested in working with learning analytics. Therefore, it is essential to create a community that has representation at the Latin American level and that can be present at these regional as well as at international conferences.

The LALA Community has an open subscription policy, so without differentiation, organizations, companies or academic entities can be added to the network. Similarly, researchers can subscribe individually to be a part of the network of LALA researchers. The mechanism for incorporating new members into the LALA Community is the approval of the membership application, made through the Membership Letter published on the web, addressed to the coordinators of the LALA Community. The coordinators inform the other members of the advisory committee about the request received, who then decide whether to approve or not the applicant's incorporation into the Community. Said decision is made through direct voting using any electronic means available, and by simple majority. To incorporate the researchers individually they must access a form where they record their data.

To be a member of the community you must follow the phases described in the Webpage of the project, where you can also get access to updated versions of the statutes.

Table 2-4 summarizes the main links to become a member of the community In the following sections each one of the phases is detailed, describing the considerations of each one in greater detail.

Phase	Instrument
1. Access the information about the LALA project	Web Site: https://www.lalaproject.org/es/inicio/
2. Registration as an institution	Statutes (A4.1, in Spanish and English): https://www.lalaproject.org/es/estatutos/ Membership letter (A4.2, in Spanish and English): https://www.lalaproject.org/wp-content/uploads/2018/02/carta.docx
3. Register as a researcher	Form: https://es.surveymonkey.com/r/ComunidadLALA

Table 2-4 Links related with the registration process for an institution or a researcher joining the LALA community.

2.6.3. Methodology

This manual was built in three stages. In the first stage, information was collected from researchers and academic staff who currently work or who wish to work with learning analytics in their daily practice. For this, and through the members of the LALA project, an open questionnaire was sent through mailing lists and academic and social networks. We identified more than a hundred researchers who are working or interested in working in LA. In the second stage, the statutes of the LALA community were developed, where the general dispositions about the functioning of the community, the objectives and integration of the LALA community, the rights and obligations of the members, and the structure of the community were established. Finally, in the third stage, a web portal was implemented to disseminate and communicate the results of the LALA project, and community initiatives.

2.6.4. LALA community activities

Resources:

- **Link to the site:** https://www.lalaproject.org/es/inicio/
- **Statutes: https://www.lalaproject.org/es/estatutos**
- **Membership Letter: https://www.lalaproject.org/wp-content/uploads/2018/02/carta.docx**
- **Registering as a researcher:** https://es.surveymonkey.com/r/ComunidadLALA

The LALA Commnity Web Site

The LALA project website contains information related to the project. For this purpose, the site is organized in 5 well-defined sections on the website's home page. These sections are: 1) About LALA, 2) LALA Community, 3) News, 4) Contact us and 5) LALA Workshops. Section 1) presents information related to the project, a general description of the objectives and the different deliverables of the project will be available. Section 2) presents the members that currently make up the community, the statutes of the community and the steps to follow to join the community. Section 3) presents news about the different activities performed by the members of the project and the LALA community. Section 4) presents a form to contact the members of the LALA project consortium. And finally, in section 5) information related to the conferences that the LALA community will organize to promote the exchange of ideas and strengthen networks of researchers in Latin America is presented. Currently, work is being done on gathering information from different researchers to add a list of researchers and learning analytics projects to this page. This information will be made throughout the project and will be added as other information to the network.

The LALA Community statutes

The statutes of the LALA community establish the general dispositions on the functioning of the community, the objectives and onboarding of the LALA community, the rights and obligations of the members, and the structure of the community. Likewise, one of the most important points of the statute refers to the membership levels of each member, which establishes different rights and obligations.

The membership letter is a request that is completed by the higher education institution interested in joining the LALA community. The statutes will be available as a document in .pdf format while the membership letter will be available as a document in .doc format.

The membership letter must specify the country and the date on which it is submitted. After this, a higher education institution's interest in forming a part of the LALA community should be briefly described. Then, the statutes must be read carefully and the level of membership in the community that the institution wishes to obtain must be marked in the membership letter. Next, in the membership letter information related to the institution and the person who will sign the membership letter must be provided. This person's signature must be representative at the level of a research group, a faculty, a school or a university. The membership letter may or may not have an official stamp of the institution. Finally, the document must be printed and signed by hand, to then be scanned and converted to pdf format before sending.

Once the document has been converted in pdf format, it must be sent by email to the community coordinators, on the following email address: lalaproject@cti.espol.edu.ec

Within 30 business days, the community coordinators will send an email to the interested institution with the response to their request.

Researcher registration form

Each researcher interested in receiving news, information and more about the project activities and the LALA community can register individually, without having to have their institution registered through a registration form. This form registers institutional data of the interested researcher, as well as his academic activity related to learning analytics.

2.6.5. Current state of the LALA community

In December 2020, the LALA community registered 126 researchers, 75% belong to public universities, 22% to private institutions and 3% to other types of institutions such as government. The researchers come from 26 different countries such as: Argentina, Costa Rica, Granada, Jamaica, Peru, Venezuela, Bolivia, Cuba, Guatemala, Mexico, Puerto Rico, Brazil, Ecuador, Guyana, Nicaragua, Dominican Republic, Chile, El Salvador, Haiti, Paraguay, Suriname, Colombia, French Guiana, Honduras, Panama and Uruguay.

Currently, there are already 83 institutions in the LALA community. The list of member institutions can be viewed through the following link: https://www.lalaproject.org/es/miembros/

During the duration of the project, the LALA community organized different activities, workshops and events related with the dissemination of LA in Latin America, as well as an annual conference to hsare and disseminate the results of the project. You can have a the complete list of events the website of the project: https://www.lalaproject.org/es/eventos/

2.6.6. The LALA SIG: Continuity to the LALA Community

To ensure the continuity of the activities of the LALA Community, and to promote new activities to foster the cooperation network of Learning Analytics in Latin America, we created in October 2020 the SOLAR Special Interest Group - LALA SIG (see the link to the LALA SIG here: https://www.solaresearch.org/community/sigs/lala-sig/).

This interest group is part of SoLAR, the Society for Learning Analytics Research, an international society that promotes research in the area of Learning Analytics. This community organizes the annual International Conference on Learning Analy**tics** & Knowledge (LAK), the leading international conference in the area of Learning Analytics, and coordinates the Learning Analytics Summer Institute (LASI). In addition, SoLAR offers financial support for the development of stakeholders to promote research in

Learning Analytics at the regional level. In 2019, the LALA project team applied for stakeholder funding from SoLAR to create the LALA SIG.

Currently, the LALA Community Coordinators are working on defining the LALA SIG charter based on the following founding objectives:

- To facilitate the exchange of information related to Learning Analytics between Latin American Higher Education Institutions and other international communities
- To offer support for the development of initiatives related to Learning Analytics in Latin America
- To offer a space for the sharing of good practices for the development of Learning Analytics research in Latin America
- To promote the development of research and practice in learning analytics in Latin America

Within the statutes, it is planned that the current members of the LALA Community will automatically become members of the LALA SIG, in order to ensure the sustainability of the community. In addition, the statutes (rules and regulations) establish the following working g**roups:**

- **Governance**: The objective of this working group is to define the structure, policies and management actions of the LALA SIG and to update the statutes accordingly. You can have a look at the current statutes in A4.3 (in English and Spanish).
- **Membership and Recruitment**: The objective of this working group is to recruit members for the LALA SIG and to energize the group for the exchange of knowledge among Latin American institutions within an international community related to LA.
- **Communication**: The objective of this working group is to oversee the internal and external communications of the LALA SIG to facilitate knowledge sharing among Latin American institutions within an international LA-related community.
- **Events**: The objective of this working group is to encourage and support the community that organizes LA-related events to further the mission of the society by expanding this field in Latin America.
- **Education**: The objective of this working group is to develop, implement and share initiatives directed at the GIS goal of LALA to promote, raise, disseminate and foster LA literacy in the region through the GIS community.

The LALA SIG was introduced formally to the LALA Community members in the LALA Conference that took place in Cuenca (Ecuador) the 1st and 2nd October 2020. However, it will start officially running from January 2021, in order to assure a smooth transition between the LALA Community and the LALA SIG.

2.7- Applying the LALA Framework Institutional Dimension

This section presents the main results of the application of the institutional manual of the LALA framework. Specifically, the data collected between January and August 2018 in the four Latin American partner institutions of the project - the Pontificia Universidad Católica de Chile (PUC), the Universidad Austral de Chile (UACh), the Escuela Politécnica del Litoral de Ecuador (ESPOL) and the Universidad de Cuenca (U. Cuenca) are presented, following the guidelines indicated in the institutional manual, as well as the results of this application.

The analysis below seeks to answer two main research questions:

- Q1. What are the educational needs for LA adoption in Latin American universities from the perspective of students, teaching staff and managers therein?
- Q2. What are the ethical considerations to be taken into account for the implementation of learning analytics in the institution?

Partial results of this analysis have been already published in different scientific journals:

- Hilliger, I., Ortíz, M., Pesantez, P., Scheihing, E., Tsai, Y.S., Muñoz-Merino, P. J., Broos, T., Pérez-Sanagustín, M. (2020) Identifying needs for learning analytics adoption in Latin American universities: A mixed-methods approach. The Internet and Higher Education, DOI:https://doi.org/10.1016/j.iheduc.2020.100726
- Hilliger, I., Ortíz-Rojas, M., Pesantez, P., Scheihing, E., Tsai, Y-S., Muñoz-Merino, P.J., Broos, T., Whitelock-Wainwright, A., Gasevic , D., Pérez-Sanagustín, M. (2020) Towards learning analytics adoption: A mixed methods study of data-related policies and policies in Latin American universities, BJET, DOI: https://doi.org/10.1111/bjet.12933
- Broos, T., Hiliger, I., Pérez-Sangustín, M., Htun, N.N., Millecamp, M., Pesántez-Cabrera, P., Solano-Quinde, L., Siguenza-Guzman, L., Verbert, K., De Laet, T., (2020) Coordinating learning analytics policymaking and implementation at scale, BJET, DOI: https://doi.org/10.1111/bjet.12934
- Hilliger, I; Pérez-Sanagustín, M.; Pérez-Álvarez, R.; Henríquez, V.; Guerra, J.; Zuñiga-Prieto, M.A.; Ortiz-Rojas, M.; Y.-S. Tsai; Gasevic, D.; Muñoz-Merino, P. J.; Broos, T.; De Laet, T.; (2020) Leadership and Maturity: How do they affect learning analytics adoption in Latin America? A cross-case analysis in Four Latin American Universities, Adoption of Data Analytics in Higher Education Learning and Teaching, Springer Ed., pp. 305-326

2.7.1. Data collection for institutional analysis

In order to collect data from the four Latin American institutions that are project partners, the different techniques stipulated in the institutional manual were used. Table 2-5 shows the data collected in each institution during the application of each of the phases. First, for the institutional diagnostic phase, LALA Canvas was used to provide an overview of LA adoption in the institution. Second, for the phase of understanding the political context and institutional needs, semi-structured interviews were conducted with institutional leaders, and focus groups with professors and students. Third, for the phase corresponding to the raising of expectations about the use of educational data of the different actors in the institution, an online questionnaire was applied to teachers and students of the indicated institutions. Finally, preliminary analyses of the data collected were carried out to inform the LA strategy of the different universities. It should be noted at this point that the strategy defined by the different universities will not be reported in this document, since it is expected that it will be defined in the final phase of the project.

Phase	Instrument	Application
1. Institucional diagnosis	LALA Canvas	Workshop held in March 2017 with the participation of 16 LA experts from different Latin American universities: ● PUC: 5

		• UACh: 3 • ESPOL: 3 • U. Cuenca: 5
2. Understand the political context and the needs of the institution- karaoke	Protocol of interviews with institutional leaders, professors, and students.	Interviews conducted between January and August 2018 with 37 institutional leaders: • PUC: 7 • UACh: 11 • ESPOL: 8 • U. Cuenca: 11 Focus Groups (FG) held between January and August 2018 to 45 students: • PUC: 14 (2 FG) • UACh: 5 (1 FG) • ESPOL: 3 (2 FG) • U. Cuenca: 24 (3 FG) Focus Groups (FG) held between January and August 2018 to 51 teachers: • PUC: 5 (1 FG) • UACh: 15 (2 FG) • ESPOL: 8 (2 FG) • U. Cuenca: 23 (3 FG)
3. Raise expectations about the use of educational data	Online questionnaires for students and teachers	Online questionnaires applied to 1,921 students and 342 teachers: • PUC: 849 students, 124 teachers • UACh: 160 students , 52 teachers • ESPOL: 177 students , 25 teachers • U. Cuenca: 735 students , 141 teachers
4. To Develop change strategy	LALA Template	Preliminary results to inform the future strategy of change towards the adoption of LA in the different institutions. (Section 8.3).

Table 2-5 Activities of the institutional manual applied during the second semester of the project. The acronyms of the different universities are: Pontificia Universidad Católica de Chile (PUC), Universidad Austral de Chile (UACh), Escuela Politécnica del Litoral de Ecuador (ESPOL) and Universidad de Cuenca (U. Cuenca).

2.7.2. Methodology of analysis

For the first three activities of the institutional dimension, a different analysis methodology was carried out. The methodology developed for each is described below.

(1) Institutional Diagnosis

The same experts who worked in the LALA Canvas of each institution summarized the elements of each dimension, with the aim of reaching a consensus on their observations of the six dimensions in their own institutional context. All these elements were documented in a Microsoft Word version of the LALA Canvas template (PUC, UACh, ESPOL, U. Cuenca).

(2) Political context and institutional needs

An expert from each institution summarized the results of the interviews according to the protocol questions provided as part of the manual (PUC, UACh, ESPOL, U. Cuenca). They then elaborated conclusions in a report focusing on the desired state of LA adoption in their institution, addressing LA tool needs, considerations for the design and implementation of LA methods, the required ethical and privacy elements, and the sustainability and scalability of LA initiatives in the region.

In addition, the experts from each institution identified the gaps between the current state and the desired state in terms of LA adoption, contrasting the elements listed in the LALA Canvas with the summarized results of the interview protocol. They then used this contrast to determine how LA could be used in their universities, as well as to anticipate issues for the future design of LA tools and methods.

In addition, from the review of the interviews and focus groups, a qualitative analysis was carried out to respond to Q1 on the needs for the adoption of learning analytics. For the analysis, we defined a series of nodes relating to the need for learning analytics from the point of view of students, teachers and administrators (Table 2-6). Four researchers participated in the analysis according to the nodes listed using the NVIVO tool.

(3) Expectations about the use of educational data

A data analysis expert carried out a statistical analysis of the questionnaires applied to students and teachers in the 4 institutions. On the one hand, the student questionnaire had 2 scales, one on normative expectations ('what I would like to happen', and another on predictive expectations ('what I think might happen'). Each scale consisted of 12 statements related to expectations about analytic and learning services, as well as ethical and privacy expectations associated with the use of educational data. On the other hand, the teachers' questionnaire also had the same two scales, but each scale consisted of 16 questions. For both questionnaires, the expert reported the average per question for each institution, as well as doing a latent class analysis to compare the results of the four institutions - taking the UACh results as a baseline (expert analysis).

Methods of analysis

In order to answer questions P1 and P2 on LA needs in the different institutions, we triangulated the data collected from the LALA Canvas, focus groups and interviews. In addition, we conducted a statistical analysis of the surveys sent to teachers and students of the different institutions to provide an overview of their perception of their institution's capacity to adopt LA. The statistical data obtained from the analysis of the questionnaires were not used in the triangulation, but offer results that will be considered in future analysis.

Table 2-6 Description of analysis nodes defined to answer questions P1 (Needs)

Cathegory/Node	**Description**
Students Needs	
Learning environment	Students' need for appropriate physical environments and cultural elements for learning.
Quality Feedback	Students' need for timely and personalized feedback to understand their learning process.
Study Strategies	Students' need for study strategies in order to approach their learning process successfully (e.g. time management).
Teachers' needs	
Course Planning	Information to review the objectives of the course, to select and organize the content of the course, to choose teaching or evaluation methods, etc.
Teaching Evaluation	Challenges related to teacher performance evaluations at the institutional level.
Student's Diversity	Teachers' need to understand different subgroups of students (for example, first year students, students with special needs, students with different learning styles, etc.)
Teaching Skills	The need for teachers to understand different subgroups of students (e.g., first-year students, students with special needs, students with different learning styles, etc.).
Management Needs	
Curricular Management	Challenges faced by managers related to curriculum design, management and planning (e.g., course planning, assigning teachers to courses, developing course-level mapping results, etc.).
Information	Need for managers to have information for decision making and the formulation and evaluation of improvement actions.
Resources	Need for managers to have information to optimize existing resources, such as time, budget, infrastructure, etc.
Student's support	Responsibilities of managers to implement corrective actions to support students (e.g. counselling)

Teachers' support	Responsibilities of managers to implement corrective actions and time to support teachers (tutoring, notifications, evaluation)

2.7.3- Results of LALA Canvas, Interviews and Focus Groups

This subsection presents the results of the LALA Canvas analysis, interviews and focus groups conducted in each institution around the two research questions: P1 on LA adoption in institutions and P2 on ethical considerations for LA capacity building in the institution.

These results are summarized below. Notice that the preliminary obtained are directly related with the Institutional dimension, although the data collected from the questionnaires applied to academic staff and students can also inform certain aspects of the ethical considerations in the Ethical dimension.

(1) Adoption needs

Table 2-7 presents the LA adoption needs identified in each of the institutions from the analysis of the LALA Canvas. As can be seen, most institutions consider LA to be a promising tool for obtaining clear information about students' progress and their academic and psychosocial-emotional profile. However, not all universities have the same needs. For example, PUC places specific emphasis on feedback, ESPOL on counseling, and UACh and UACh on monitoring high failure rates and dropout risks. Therefore, and as Gasevic (2018) argues, the "one-size-fits-all" approach does not work for data models and, according to our results, may not work for LA adoption models either. In the next phases of the project, and once the pilots are done, more conclusions can be drawn on this point.

Table 2-7 Preliminary results on the analysis of the institutional needs for the adoption of LA in the 4 Latin American universities of the project.

	Needs for the adoption of LA
PUC	● Timely and personalized feedback to improve the teaching and learning process. ● Academic support for subgroups of students (such as freshmen and students with special needs). ● Information about the academic progress of students at one level of the curriculum. ● Clear information about the academic burden on students.
UACh	● Punctual and personalised monitoring of the performance of students and teachers. ● Information on students' academic progress at the curriculum level. ● Information on the academic load of students. ● Information on students' academic and psycho-social-emotional profiles. ● Indicators of failure rates and risk of academic abandonment.
ESPOL	● Improvements to existing LA tools at the institutional level (e.g. an advisory tool). ● Exploitation of educational data collected from both teachers and students.

	● Integrated systems to obtain information on the academic and psycho-social-emotional profile of students.
U. Cuenca	● Punctual and personalized monitoring of the performance of students and teachers. ● Indicators of high failure rates and risk of academic abandonment. ● Information on students' academic progress at the curriculum level. ● Information on student satisfaction at the course and program level. ● Information on students' academic and psycho-social-emotional profiles. ● Information on the academic load of students.

(2) Ethical considerations for LA capacity building in the institution

Table 2-8 shows the preliminary results on the ethical considerations detected in the different institutions for the future design of LA tools and methodologies respectively. As can be seen in the table, most institutions referred to the need to develop ethics-related policies to address issues related to informed consent of data, its access and transparency in its use. This result is in line with what is suggested in the current bibliography, which highlights the need to develop clear data and information processing policies in institutions that ensure privacy and transparent use (Gasevic, 2018; Steiner et al., 2015). In addition, most institutions placed special emphasis on the need for procedures to ensure data transparency, which is an important issue when adopting LA at the institutional level. In addition to common considerations, different ethical needs were also identified in some universities. For example, PUC emphasized the institutional establishment of informed consent for students about the use of their data. On the other hand, the UACh and U. Cuenca universities emphasized the need for institutional training in the areas of privacy and data use.

Table 2-8 Ethical Considerations Identified

	Ethical considerations
PUC	● Need for rigorous processes for informed consent. ● Need for procedures for data transparency. ● Development of policies to maintain ethical practices in the handling of educational data.
UACh	● Importance of information security compliance. ● Need for staff training on privacy.
ESPOL	● Development of policies to maintain data access, data transparency and informed consent practices.
U. Cuenca	● Need for rigorous processes for informed consent. ● Need for procedures for data transparency. ● Development of policies to maintain ethical practices. ● Importance of information security compliance. ● Need for staff training on privacy.

Figure 2-10 shows that the three main actors of the institutions analyzed have different needs that converge on some points**. Students emphasize that LA solutions should serve their learning process both at the feedback level and at the institutional support level**. On the one hand, they highlight the need for solutions that are able to provide quality and timely feedback during their learning process. When referring to quality feedback, students use words such as "personalized" and "on time", that is, able to inform them about their performance and curricular progress at the appropriate time. In addition, they also mention that it is important to offer services able to inform them about their emotional state in relation to the rest of the students in order to avoid dropouts and maintain their motivation throughout the course.

Teachers point out that LA's solutions should offer support to improve their performance as teachers both in their daily practices and in their skills. On the one hand, teachers emphasize that they need solutions capable of providing them with information that accounts for their teaching performance in a more meaningful way than current teacher surveys, in order to adjust their teaching practices. One of the aspects that stands out as something important is that this information must arrive in time to react during the development of the course and not at the end, as is usually the case in most current evaluation instances. In addition, they also coincide with the students' perspective on the use of LA solutions to provide information on the learners' emotional situation, in order to detect students at risk of dropping out and act in time.

Finally, **managers see LA solutions as a tool to provide actionable information to support decision making related to students, faculty and institutional strategy.** On the one hand, they consider that these solutions should offer actionable information to anticipate problems with professors and students. Information about professors is relevant for evaluating their performance and launching improvement policies, while information about students helps to understand where they encounter greater difficulties in the development of their studies. On the other hand, administrators see LA solutions as a tool to have an overview of the institution capable of crossing data to support the definition of institutional strategies related to curriculum, accreditations, or course improvement.

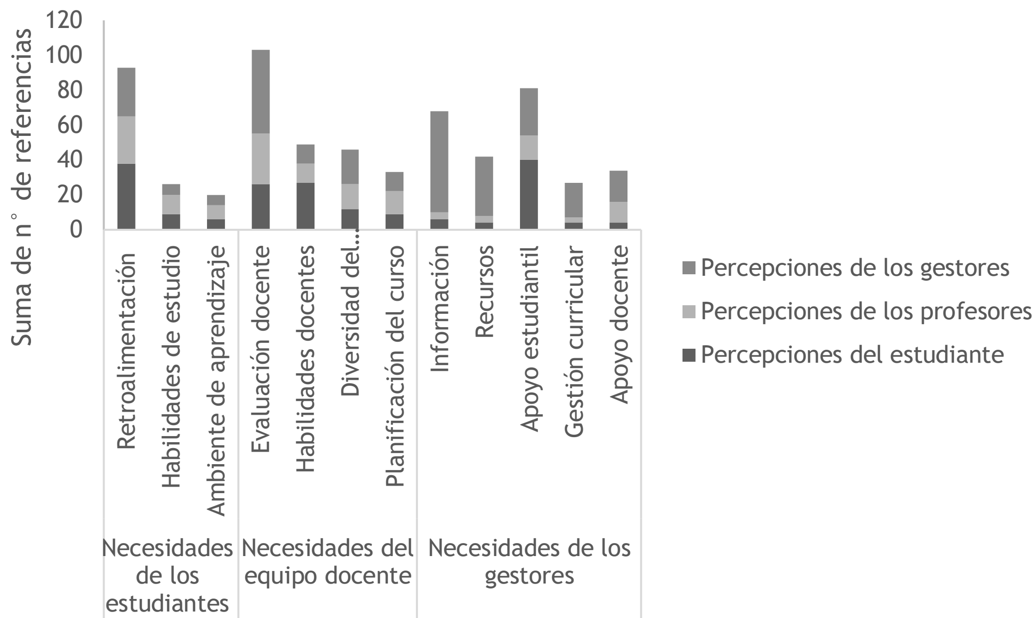


Figure 2-10 Results of the coding of interviews and focus groups in relation to the adoption needs of LA for each of the actors of the institution: students, teachers and administrators.

2.7.4- Results of questionnaires to students and teachers

Figure 2-11 and Figure 2-12 show the averages of the responses to the student and teacher questionnaires, respectively. According to the results shown in these figures, both students and teachers have higher expectations of LA data management standards and services than predictive expectations. This suggests that both actors already have an awareness of the use of institutional data and its potential for LA services.

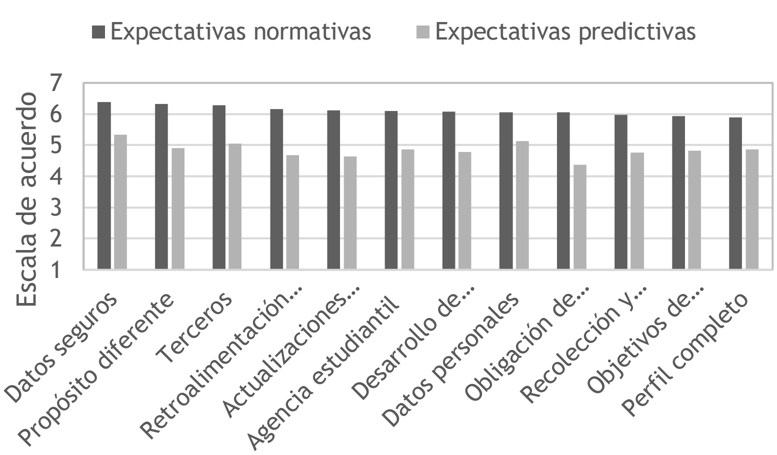


Figure 2-11 Averages of student responses to statements that account for normative and predictive expectations with learning analytics services and ethical considerations of their implementation.

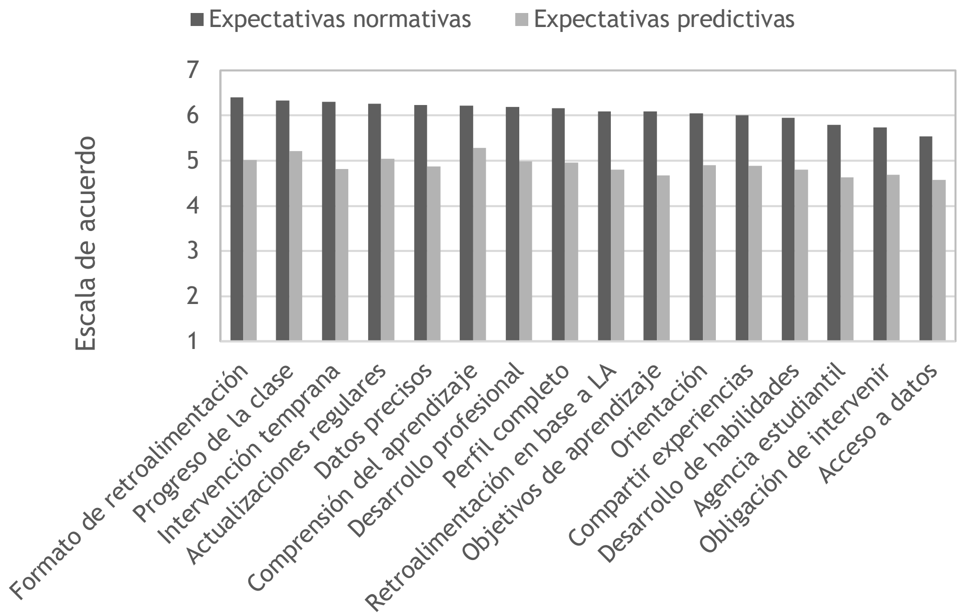


Figure 2-12 Averages of teacher responses to statements that account for normative and predictive expectations with learning analytics services and ethical considerations of their implementation.

Student Questionnaire responses

A total of 1884 responses were collected from four institutions using the SELAQ (the Student Expectations of Learning Analytics Questionnaire). From each individual higher education institution the responses were as follows: 205 (ESPOL), 878 (PUC), 228 (UACH), and 573 (UCuenca). The average of the whole sample of students was 22.50 years (SD = 4.59), with a maximum age of 63 and a minimum age of 17. With regards to gender, 958 (50.60%) students were male, 918 (48.70%) students were female, and 12 (.64%) students responded with prefer not answer. Majority of the overall student sample were Undergraduates (n = 1708, 90.70%), followed by Masters (n = 91, 4.83%) and PhD (n = 51, 2.71%). 29 students reported that they were studying both an Undergraduate and Masters course (n = 29, 1.54%), one student (.05%) stated they were doing an Undergraduate and PhD course, one student (.05%) stated they were doing both a Masters and PhD course, and three students (.16%) stated they were doing an Undergraduate, Masters, and PhD course.

Five items of the SELAQ refer to Ethical and Privacy Expectations, these were abbreviated as follows: Identifiable Data (Item 1), Keep Secure (Item 2), Third Parties (Item 3), Consent to Use (Item 5), and Alternative Use (Item 6).

With regards to the expectation of seeking consent to use identifiable data, majority of students strongly agreed to this action across all universities on the ideal expectation scale (49.27%, 62.41%, 67.11%, and 58.99% for ESPOL, PUC, UACH, and UCuenca, respectively). As for the predicted expectation scale, the proportion of students strongly agreeing dropped to 31.71% (ESPOL), 23.23% (PUC), 29.39% (UACH), and 30.37% (UCuenca). Even though responses showed expectations to not be comparable with the predicted scale, majority of students still expressed some level of agreement (somewhat agreed, agreed, or strongly agreed) with this item (68.30% for ESPOL, 69.36% for PUC, 61.55% for UACH, and 71.56% for UCuenca).

The majority of students also strongly agreed that they ideally expected the university to ensure any collected data remained secure (66.83%, 74.03%, 78.07%, and 73.30% for ESPOL, PUC, UACH, and UCuenca, respectively). As for the predicted expectation scale, 66.83% of the ESPOL student sample strongly agreed to the Keep Secure item. As for PUC, UACH, and UCuenca the respective percentages for strongly agreeing were 26 .88%, 28.07%, and 37.00%. Irrespective of this drop in the proportion of students expressing strong agreement with item 2, 91.71% (ESPOL), 75.85% (PUC), 74.56% (UACH), and 75.92% (UCuenca) of students expressed some form of agreement (somewhat agreed, agreed, or strongly agreed).

As for the expectation that consent should be sought before data is passed onto third parties (item 3), majority of students again ideally expected this to happen (ESPOL = 58.54%, PUC = 74.94%, UACH = 78.07%, and UCuenca = 68.24%). As for whether these students expected this to occur in reality, the majority of the sample (ESPOL = 66.35%, PUC = 66.41, UACH = 64.04%, and UCuenca = 75.05%) expressed some form of agreement (somewhat agreed, agreed, or strongly agreed) to this item.

For the item asking whether consent should be sought before data is collected and analysed by the university (item 5), majority of students ideally expected this to happen (ESPOL = 51.71%, PUC = 57.06%, UACH = 64.91%, and UCuenca = 55.15%). In relation to the predicted expectation scale, the responses again showed most students to agree to some extent (somewhat agreed, agreed, or strongly agreed) with the Consent to Use item (ESPOL = 71.22%, PUC = 53.99%, UACH = 60.09%, UCuenca = 70.33%).

The remaining Ethical and Privacy Expectations item (item 6) refers to obtaining consent before data is used for an alternative purpose. On the ideal expectation scale, majority of students strongly agreed to this item (ESPOL = 60.98%, PUC = 74.49%, UACH = 74.56%, and UCuenca = 67.71%). For the predicted expectation, fewer students responded with strongly agree, but majority of students (ESPOL = 71.71%, PUC = 61.05%, UACH = 53.39%, and UCuenca = 71.37%) agreed to some extent (somewhat agreed, agreed, or strongly agreed).

Seven items of the SELAQ refer to Service Feature Expectations, these were abbreviated as follows: Regular Updates (Item 4), Student Decision Making (Item 7), Learning Goals (Item 8), Complete Profile (Item 9), Teacher Feedback (Item 10), Obligation to Act (Item 11), and Skill Development (Item 12).

When asked about receiving regular updates from the university about their learning (item 4), majority of students strongly agreed that they ideally expected this to happen (ESPOL = 59.02%, PUC = 56.95%, UACH = 67.11%, and UCuenca = 57.59%). As to whether students expected to receive regular updates in reality, 32.68% of the ESPOL student sample strongly agreed, compared to 11.05%, 17.11%, and 26.88% for PUC, UACH, and UCuenca, respectively. As with ESPOL, the largest response for UCuenca was for strongly agree (26.88%). Whereas, for PUC and UACH the highest percentage was for the somewhat agree category (PUC = 25.40% and UACH = 25.00%). Despite this, 15.83% (PUC) and 13.60% (UACH) of students somewhat disagreed that the university would implement this feature in reality; 10.48% (PUC) and 7.02% (UACH) students also disagreed with item 4.

Ideal expectation scale responses to item 7, which stated that learning analytics services should promote student decision making, received strong agreement from majority of students (ESPOL = 52.68%, PUC = 56.83%, UACH = 54.82%, and UCuenca = 54.62%). As for the predicted expectation scale, the percentage of students strongly agreeing to item 7 did drop (ESPOL = 27.80%, PUC = 13.44%, UACH = 17.54%, and UCuenca = 24.96%; nevertheless, majority of the sample still agreed to some extent (Agree: ESPOL = 25.85%, PUC = 18.34%, UACH = 17.98%, and UCuenca = 20.59%; Somewhat Agree: ESPOL = 19.02%, PUC = 28.93%, UACH = 18.86%, and UCuenca = 21.12%). With regards to students disagreeing to the expectation conveyed in item 7, 11.05% (PUC), 15.35% (UACH), and 10.47% (UCuenca) students somewhat disagreed that it would occur in reality.

Across each of the four higher education institutions, a high proportion of students strongly agreed that they ideally expected to know how progress compared to a set set goal (ESPOL = 44.88%, PUC = 45.79%, UACH = 52.19%, and UCuenca = 49.56%). Although the proportion of students strongly agreeing on the predicted expectation scale did drop (ESPOL = 27.32%, PUC = 12.76%, UACH = 16.67%, and UCuenca = 22.69%), the majority of students (ESPOL = 77.57%, PUC = 56.38%, UACH = 57.90%, UCuenca = 68.94%) in the sample expressed some form of agreement (somewhat agreed, agreed, strongly). For PUC and UACH, 11.96% and 11.40% of students reported that they somewhat disagreed (on the predicted expectation scale) that the university would allow them to compare progress to a set goal, respectively.

Receiving a complete learning profile (item 9), on the ideal expectation scale, had a large proportion of students responding with strongly agree (ESPOL = 46.34%, PUC = 48.41%, UACH = 55.70%, and UCuenca = 52.01%). As with other variables, the proportion of students strongly agreeing to this expectation dropped on the predicted expectation scale (ESPOL = 25.85%, PUC = 14.58%, UACH = 21.05%, UCuenca = 24.96%). Irrespective of this decline, a high proportion of students (ESPOL = 75.09%, PUC = 58.20%, UACH = 60.08%, UCuenca = 68.59%) continued to express some form of agreement (somewhat agreed, agreed, or strongly agreed) to item 9. As for students disagreeing to this item on the predicted expectation scale, two of the largest proportions of students were for PUC (11.96%) and UACH (13.16%) for somewhat disagree.

Teaching staff having the skills needed to incorporate learning analytics into their feedback (item 10) did receive a large proportion of students strongly agreeing on the ideal expectation scale (ESPOL = 51.71%, PUC = 58.77%, UACH = 59.65%, and UCuenca = 56.89%). For the predicted scale, the proportion of strongly agree responses did drop (ESPOL = 24.39%, PUC = 12.98%, UACH = 18.42%, and UCuenca = 23.21%), but the overall expression of agreement (somewhat agreed, agreed, or strongly agreed) with this item was high for each institution (ESPOL = 69.76%, PUC = 54.21%, UACH = 56.14%, and UCuenca = 63.53%). With regards to students expressing some form of disagreement (somewhat disagreed, disagreed, or strongly disagreed), the largest proportion was for PUC (30.18%), followed by UACH (27.63%), UCuenca (23.56%), and then ESPOL (14.63%).

Expectations towards teaching staff having an obligation to act (item 11) were quite varied across the four institutions. With regards to the ideal expectation scale, a large proportion of students strongly agreed to this item (ESPOL = 55.12%, PUC = 55.69%, UACH = 61.84%, and UCuenca = 62.48%). On the predicted expectation scale, the proportion of students disagreeing was found to increase considerably in comparison to the ideal expectation scale. For instance, on the ideal expectation scale the responses across strongly disagree, disagree, and somewhat disagree were as follows 2.62%, 1.48%, and 3.30%, respectively. Whereas, for the predicted expectation scale this increased to 10.59% (strongly disagree), 12.30% (disagree), and 15.38% (somewhat disagree). Similar changes in response proportions were also noted for ESPOL (ideal expectation scale: strongly disagree = 4.89%, disagree = 2.44%, and somewhat disagree = .98%; predicted expectation scale: strongly disagree = 7.32%, disagree = 6.34%, and somewhat disagree = 7.32%), UACH (ideal expectation scale: strongly disagree = 3.51%, disagree = 1.75%, and somewhat disagree = 3.51%; predicted expectation scale: strongly disagree = 10.09%, disagree = 7.89%, and somewhat disagree = 16.67%), and UCuenca (ideal expectation scale: strongly disagree = 3.84%, disagree = 1.57%, and somewhat disagree = 2.79%; predicted expectation scale: strongly disagree = 9.95%, disagree = 8.55%, and somewhat disagree = 10.47%).

The remaining item refers to whether students expect the learning analytics service should be used to promote skill development (academic and professional; item 12). With regards to the ideal expectation scale a high proportion of students strongly agreed with this item (ESPOL = 55.12%, PUC = 54.56%, UACH = 61.84%, and UCuenca = 57.77%). As for the predicted expectation scale, responses were varied. For one, the proportion of strongly agree responses declined (ESPOL = 27.32%, PUC = 13.78%, UACH = 20.18%, and UCuenca = 26.18%). In addition, there was an increase in the number of students that expressed some form of disagreement to the item compared to the ideal expectation scale for PUC (ideal expectation scale: strongly disagree = 2.96%, disagree = 1.37%, and somewhat disagree = 1.94%; predicted expectation scale: strongly disagree = 5.35%, disagree = 6.83%, and somewhat disagree = 11.28%), UACH (ideal expectation scale: strongly disagree = 3.07%, disagree = 1.75%, and somewhat disagree = 1.32%; predicted expectation scale: strongly disagree = 6.14%, disagree = 9.65%, and somewhat disagree = 11.40%), and UCuenca (ideal expectation scale: strongly disagree = 3.49, disagree = 2.09%, and somewhat disagree = 1.22%; predicted expectation scale: strongly disagree = 5.24%, disagree = 4.89%, and somewhat disagree = 9.60%).

Staff Questionnaire responses

A total of 429 responses were received across the four institutions (ESPOL, PUC, UACH, and UCuenca). The number of responses per institution were as follows: 25 (ESPOL), 124 (PUC), 79 (UACH), and 201 (UCuenca).

The staff questionnaire contains 16 items that cover an array of themes including data access, how the data will be used to improve student learning, and how the university can support staff being involved in learning analytics.

When asked whether academic staff expect to have access to the data collected about their students, responses were quite positive on the ideal expectation scale. For ESPOL, 60% of staff strongly agreed to this item; whereas, 29.03%, 45.57%, and 45.71% strongly agreed for PUC, UACH, and UCuenca. As for whether this would occur in reality (predicted expectation scale) only 4% of ESPOL staff somewhat disagreed with this expectation item, no other disagreement was expressed. As for PUC, 8.87%, 12.90%, and 12.90% members of staff respectively strongly disagreed, disagreed, or somewhat disagreed. For UACH, 31.65% of staff disagreed to some extent (Strongly Disagree = 3.80%, Disagree = 11.39%, and Somewhat Disagree = 16.46%) and this was 28.57% for UCuenca (Strongly Disagree = 5.71%, Disagree = 7.86%, and Somewhat Disagree = 15%).

In regard to whether staff expected to access guidance on how to access the analytics related to their students, a large proportion strongly agreed that they would like this to happen (ESPOL = 64%, PUC = 50%, UACH = 55.70%, and UCuenca = 52.14%). As to whether this would occur in reality (predicted expectation scale), the amount of staff strongly agreeing did decrease (ESPOL = 28%, PUC = 15.32%, UACH = 10.13%, and UCuenca = 19.29%). As for staff disagreeing in some way (Strongly Disagreeing, Disagreeing, or Somewhat Disagreeing) that this would occur in reality, 12% responded this way in ESPOL, 11.30% in PUC, 22.79% in UACH, and 26.43% in UCuenca.

Majority of respondents strongly agreed that they ideally expected the university to provide accurate data in any learning analytics feedback (ESPOL = 68%, PUC = 56.45%, UACH = 64.56%, and UCuenca = 55.71%). As for the predicted expectation scale, 36% of staff strongly agreed to this item, with only 12.90%, 16.46%, and 20% doing so for PUC, UACH, and UCuenca, respectively. Disagreement was expressed in some way (Strongly Disagree, Disagree, Somewhat Disagree), on the predicted expectation, by 16% (ESPOL), 20.98% (PUC), 22.78% (UACH), and 23.57% (UCuenca) of staff members.

Using learning analytics for the purpose of better understanding students' learning performance received a large response in terms of staff strongly agreeing that they would ideally like it to happen (ESPOL = 60%, PUC = 56.45%, UACH = 62.03%, and UCuenca = 55%). For the predicted scale, staff did not express much disagreement with regards to this item in terms of strongly disagreeing, disagreeing, or somewhat disagreeing (ESPOL: Strongly Disagree = 0%, Disagree = 4%, and Somewhat Disagree = 0%; PUC: Strongly Disagree = 1.61%, Disagree = .81%, and Somewhat Disagree = 2.42%; UACH: Strongly Disagree = 2.53%, Disagree = 2.53%, and Somewhat Disagree = 11.39%; UCuenca: Strongly Disagree = 4.29%, Disagree = 7.14%, and Somewhat Disagree = 7.14%). Teaching staff were, however, more positive that learning analytics would provide a deeper understanding of their students' learning performance (ESPOL: Strongly Agree = 20%, Agree = 32%, and Somewhat Agree = 20%; PUC: Strongly Agree = 28.23%, Agree = 27.42%, and Somewhat Agree = 24.19%; UACH: Strongly Agree = 24.05%, Agree = 27.85%, and Somewhat Agree = 20.25%; UCuenca: Strongly Agree = 21.43%, Agree = 25%, and Somewhat Agree = 23.57%).

Majority of respondents from ESPOL strongly agreed (72%) that they would ideally like the university to have early alert systems in place. Large responses for strongly agree were also found for PUC (58.87%), UACH (59.49%), and UCuenca (53.57%). In relation to the predicted expectation scale, the proportion of respondents strongly agreeing dropped to 36% for ESPOL, 17.74% for PUC, 11.39% for UACH, and 19.29% for UCuenca. For ESPOL, there were no negative responses on the ideal expectation scale; however, this increased to 20% (Strongly Disagree = 4%, Disagree = 12%, and Somewhat Disagree = 4%) on the predicted expectation scale. In relation to the three remaining institutions, the proportion of staff disagreeing that early alert systems would be implemented in reality was moderate (PUC: Strongly Disagree = 1.61%, Disagree = 5.65%, and Somewhat Disagree = 7.26%; UACH: Strongly Disagree = 2.53%, Disagree = 15.19%, and Somewhat Disagree = 12.66%; UCuenca: Strongly Disagree = 5.71%, Disagree = 7.14%, and Somewhat Disagree = 12.14%).

A large response to the strongly agree category for the learning analytics feedback being understandable and easy to read item was found for the ideal expectation scale (ESPOL = 68%, PUC = 66.94%, UACH = 68.35%, and UCuenca = 62.14%). For the predicted expectation scale this dropped to 28%, 17.74%, 21.52%, and 21.43% for ESPOL, PUC, UACH, and UCuenca, respectively. Majority of respondents still agreed to some extent that this would occur in reality (ESPOL: Agree = 24% and Somewhat Agree = 20%; PUC: Agree = 20.97% and Somewhat Agree = 26.61%; UACH: Agree = 21.52% and Somewhat Agree = 18.99%; UCuenca: Agree = 27.86% and Somewhat Agree = 20.71%).

In terms of whether academic staff ideally expect students to received feedback on how their progress compares to set goals, a large proportion strongly agreed (ESPOL = 56%, PUC = 53.23%, UACH = 54.43%, and UCuenca = 49.29%); the proportion strongly agreeing on the predicted expectation scale dropped (ESPOL = 20%, PUC = 14.52%, UACH = 11.39%, and UCuenca = 17.86%). The proportion of academic staff disagreeing in some way (Strongly Disagreed, Disagreed, or Somewhat Disagreed) did increase on the predicted expectation scale in comparison to the ideal expectation scale (ESPOL: ideal expectation scale = 0% and predicted expectation scale = 20%; PUC: ideal expectation scale = 3.23% and predicted expectation scale = 25.01%; UACH: ideal expectation scale = 7.60% and predicted expectation scale = 25.32%; UCuenca: ideal expectation scale = 5% and predicted expectation scale = 27.14%).

For the expectation that students would receive a complete profile of their learning, a large proportion of staff strongly agreed that they ideally expected this to happen (ESPOL = 48%, PUC = 50%, UACH = 59.49%, and UCuenca = 57.14%). For the predicted expectation scale this response to the strongly agree category dropped to 28%, 17.74%, 15.19%, and 17.86% for ESPOL, PUC, UACH, and UCuenca, respectively. A large proportion of respondents still responded positively, however (ESPOL: Agree = 16% and Somewhat Agree = 28%; PUC: Agree = 24.19% and Somewhat Agree =23.39%; UACH: Agree = 24.05% and Somewhat Agree = 21.52%; UCuenca: Agree = 25% and Somewhat Agree = 25.71%). Disagreement to this item on the predicted expectation scale was low (ESPOL: Strongly Disagree = 4%, Disagree = 4%, and Somewhat Disagree = 4%; PUC: Strongly Disagree = 2.42%, Disagree = 3.23%, and Somewhat Disagree = 10.48%; UACH: Strongly Disagree = 2.53%, Disagree = 5.06%, and Somewhat Disagree = 8.86%; UCuenca: Strongly Disagree = 5%, Disagree = 5.71%, and Somewhat Disagree = 9.29%).

When asked whether they expect the university to have an obligation to act when students are identified as at-risk or underperforming, a large proportion of staff strongly agree that they would ideally like this to happen (ESPOL = 52%, PUC = 44.35%, UACH = 46.84%, and UCuenca = 45%). As for whether they expected this to happen in reality (predicted expectation scale), the proportion of respondents strongly agreeing did drop but a agreement with this item was still moderate (ESPOL: Strongly Agree = 16%, Agree = 20%, and Somewhat Agree = 32%; PUC: Strongly Agree = 16.94%, Agree = 16.94%, and Somewhat Agree = 25%; UACH: Strongly Agree = 12.66%, Agree = 15.19%, and Somewhat Agree = 25.32%; UCuenca: Strongly Agree = 15.71%, Agree = 22.14%, and Somewhat Agree = 22.86%). As for respondents disagreeing in some way on the predicted expectation scale, this was moderate (ESPOL: Strongly Disagree = 0%, Disagree = 12%, and Somewhat Disagree = 8%; PUC: Strongly Disagree = 1.61%, Disagree = 4.84%, and Somewhat Disagree = 15.32%; UACH: Strongly Disagree = 5.06%, Disagree = 7.59%, and Somewhat Disagree = 13.92%; UCuenca: Strongly Disagree = 6.43%, Disagree = 7.86%, and Somewhat Disagree = 13.57%).

Respondents appeared to strongly agreed with providing staff with opportunities for professional development on the ideal expectation scale (ESPOL = 48%, PUC = 52.42%, UACH = 58.23%, and UCuenca = 56.43%). The proportion of responses to the agreement categories were still large on the predicted expectation scale (ESPOL: Strongly Agree = 20%, Agree = 20%, and Somewhat Agree = 36%; PUC: Strongly Agree = 16.94%, Agree = 33.06%, and Somewhat Agree = 29.03%; UACH: Strongly Agree = 16.46%, Agree = 13.92%, and Somewhat Agree = 22.78%; UCuenca: Strongly Agree = 20%, Agree = 22.14%, and Somewhat Agree = 8.57%). The level of disagreement for this item on the predicted scale was moderate (ESPOL: Strongly Disagree = 0%, Disagree = 4%, and Somewhat Disagree = 12%; PUC: Strongly Disagree = 1.61%, Disagree = 1.61%, and Somewhat Disagree = 3.23%; UACH: Strongly Disagree = 0%, Disagree = 13.92%, and Somewhat Disagree = 16.46%; UCuenca: Strongly Disagree = 2.86%, Disagree = 9.29%, and Somewhat Disagree = 15%).

Staff had strong ideal expectations that the learning analytics service would regularly update students (Strongly Agree: ESPOL = 64%, PUC = 54.84%, UACH = 60.76%, and UCuenca = 60%). This did decline for the predicted expectation scale (Strongly Agree: ESPOL = 28%, PUC = 20.97%, UACH = 20.25%, and UCuenca = 25.71%). In terms of staff disagreeing in any way that this would happen in reality, the largest response was for the somewhat disagree category (ESPOL = 4%, PUC = 7.26%, UACH = 15.19%, and UCuenca = 11.43%).

Staff being able to share their experiences of learning analytics services did receive strong agreement from a large proportion of respondents on the ideal expectation scale (ESPOL = 56%, PUC = 45.16%, UACH = 46.84%, and UCuenca = 50%). With regards to the predicted expectation scale, respondents still generally agreed with being able to share their experience with others (ESPOL: Strongly Agree = 24%, Agree = 16%, and Somewhat Agree = 32%; PUC: Strongly Agree = 17.74%, Agree = 22.58%, and Somewhat Agree = 25%; UACH: Strongly Agree = 11.39%, Agree = 18.99%, and Somewhat Agree = 20.25%; UCuenca: Strongly Agree = 20.71%, Agree = 23.57%, and Somewhat Agree = 22.14%). With regards to disagreement on this item on the predicted expectation scale, responses were low to moderate (ESPOL: Strongly Disagree = 4%, Disagree = 4%, and Somewhat Disagree = 12%; PUC: Strongly Disagree = .81%, Disagree = 4.03%, and Somewhat Disagree = 10.48%; UACH: Strongly Disagree = 1.27%, Disagree = 11.39%, and Somewhat Disagree = 15.19%; UCuenca: Strongly Disagree = 2.14%, Disagree = 10.71%, and Somewhat Disagree = 7.14%).

With regard to providing staff with opportunities of professional development, a large proportion of respondents strong agreed that they would ideally like this to happen (ESPOL = 48%, PUC = 52.42%, UACH = 58.23%, and UCuenca = 56.43%). Responses on the predicted expectation were positive yet not as a comparable to the ideal expectation scale (ESPOL: Strongly Agree = 20%, Agree = 20%, and Somewhat Agree = 36%; PUC: Strongly Agree = 16.94%, Agree = 33.06%, and Somewhat Agree = 29.03%; UACH: Strongly Agree = 16.46%, Agree = 13.92%, and Somewhat Agree = 22.78%; UCuenca: Strongly Agree = 20%, Agree = 25%, and Somewhat Agree = 19.29%). In relation to respondents disagreeing on this item on the predicted expectation scale, responses were low to moderate (ESPOL: Strongly Disagree = 0%, Disagree = 4%, and Somewhat Disagree = 12%; PUC: Strongly Disagree = 1.61%, Disagree = 1.61%, and Somewhat Disagree = 3.23%; UACH: Strongly Disagree = 0%, Disagree = 13.92%, and Somewhat Disagree = 16.46%; UCuenca: Strongly Disagree = 2.86%, Disagree = 9.29%, and Somewhat Disagree = 15%).

The largest response on the ideal expectation scale for students being able to make their own decision on the data provided was for strongly agree (ESPOL = 40%, PUC = 36.29%, UACH = 41.77%, and UCuenca = 42.86%). As for whether this would occur in reality (predicted expectation scale), responses still remained largely positive (ESPOL: Strongly Agree = 24%, Agree = 36%, and Somewhat Agree = 12%; PUC: Strongly Agree = 12.10%, Agree = 20.16%, and Somewhat Agree = 23.39%; UACH: Strongly Agree = 6.33%, Agree = 16.46%, and Somewhat Agree = 31.65%; UCuenca: Strongly Agree = 17.14%, Agree = 20.71%, and Somewhat Agree = 21.43%). As for disagreement with this particular item and whether it would realistically happen, this was fairly low (ESPOL: Strongly Disagree = 4%, Disagree = 12%, and Somewhat Disagree = 4%; PUC: Strongly Disagree = 3.23%, Disagree = 8.87%, and Somewhat Disagree = 12.90%; UACH: Strongly Disagree = 5.06%, Disagree = 12.66%, and Somewhat Disagree = 8.86%; UCuenca: Strongly Disagree = 5%, Disagree = 6.43%, and Somewhat Disagree = 12.42%).

Knowing how students were progressing within a course received strong ideal expectations across each institution (Strongly Agree: ESPOL = 72%, PUC = 60.48%, UACH = 60.76%, and UCuenca = 60.71%). Agreement was still large on the predicted expectation scale (ESPOL: Strongly Agree = 36%, Agree = 16%, and Somewhat Agree = 32%; PUC: Strongly Agree = 26.61%, Agree = 29.84%, and Somewhat Agree = 16.94%; UACH: Strongly Agree = 20.25%, Agree = 17.72%, and Somewhat Agree = 29.11%; UCuenca: Strongly Agree = 27.14%, Agree = 21.43%, and Somewhat Agree = 25%). Disagreement as to whether this would occur in reality was found to be low (ESPOL: Strongly Disagree = 0%, Disagree = 0%, and Somewhat Disagree = 8%; PUC: Strongly Disagree = 1.61%, Disagree = 5.65%, and Somewhat Disagree = 5.65%; UACH: Strongly Disagree = 1.27%, Disagree = 7.59%, and Somewhat Disagree = 10.13%; UCuenca: Strongly Disagree = 5%, Disagree = 3.57%, and Somewhat Disagree = 9.29%).

Teaching staff having the skills necessary to incorporate learning analytics into the feedback they provide did receive a large proportion of respondents strongly agreeing with the item on the ideal expectation scale (ESPOL = 48%, PUC = 49.19%, UACH = 56.96%, and UCuenca = 50.71%). The amount of respondents strongly agreeing on the predicted expectation scale did drop (ESPOL = 24%, PUC = 12.10%, UACH = 16.46%, and UCuenca = 15.71%); however, teaching staff still generally agreed to some extent (ESPOL: Agree = 28% and Somewhat Agree = 24%; PUC: Agree = 19.35% and Somewhat Agree = 28.23%; UACH: Agree = 16.46% and Somewhat Agree = 22.78%; UCuenca: Agree = 25.71% and Somewhat Agree = 25%). As for disagreement as to whether this would occur in reality, the proportion of responses for these categories was low (ESPOL: Strongly Disagree = 0%, Disagree = 8%, and Somewhat Disagree = 4%; PUC: Strongly Disagree = 3.23%, Disagree = 4.84%, and Somewhat Disagree = 14.52%; UACH: Strongly Disagree = 2.53%, Disagree = 8.86%, and Somewhat Disagree = 10.13%; UCuenca: Strongly Disagree = 5%, Disagree = 5.71%, and Somewhat Disagree = 12.14%).

2.7.5- Data cross-analysis: Educational needs for LA in Latin America

This section summarizes the main results of cross-analy**z**ing the data collected from the four institutions when applying the instruments of the institutional dimension. The findings were organized by the different stakeholders: students, academic staff and managers. This cross-analysis was conducted by three of the researchers involved in the project using the qualitative data analysis software NVivo.

Five main educational needs regarding LA in Latin American regions were identified:

1. **Students need quality feedback and data-driven support from teaching staff to improve their learning results.** This result is supported by qualitative and quantitative data: 72% of students' references about their needs for LA services alluded to quality feedback; while 88% of students survey respondents agreed with the following statement of the ideal expectations scale 'Ideally, the teaching team will be able to provide me with information and support based on the results obtained through the analysis of my educational data.
2. **Students need timely support interventions from staff and managers when they are facing difficulties that affect their academic performance**. 69% of the coding references obtained from students about managerial needs for LA services alluded to student support. Also, 4% of students survey respondents agreed with the following statement of the ideal expectations scale: 'Ideally, the teaching staff will have the obligation to support me if the results obtained from the analysis of my educational data show that my that my performance is below the average, that I am at risk of being suspended (…).'

3. **Teaching staff need timely alerts from managers to provide better support to students who are facing difficulties that affect their academic performance.** 70% of the coding references obtained from teaching staff about managerial needs for LA services alluded to student and teacher support (38% and 32% percent respectively). Regarding the survey's responses, 86% of staff survey respondents agreed with the following statement of the ideal expectations scale 'The university will provide support to the student as soon as possible if the analysis of the student's educational data suggests that he may be having some difficulty or problem.'
4. **Teaching staff need meaningful and "easy-to-use" feedback about their performance and the quality of their teaching to inform their practice.** 43% of staff references obtained about their needs for LA services alluded to performance evaluation, followed by managing student diversity (21%), addressing course planning (20%), and developing teaching skills (16%). Also, 88% of staff survey respondents agreed with the statement 'Ideally, the information provided by the services associated with the use of educational data will be displayed in a comprehensible and easy to read format'.
5. **Managers need quality information from staff to evaluate support interventions targeted to students.** 37% of managers' references about their needs for LA services alluded to information to evaluate support interventions, followed by information to optimize resources (22%).

2.7.6- Conclusions and next steps

The results of the Institutional dimension need for LA adoption in the 4 Latin American partner universities shows that the "one-size-fits-all" approach may not work when models for large-scale LA adoption are proposed. Although the results show that most institutions viewed LA as a promising tool for obtaining information on student progress and their academic or psychosocial-emotional profiles, there were different institutional needs among universities, even among institutions in the same country. In addition, there are a number of ethical concerns, such as the need for ethics-related policies and procedures to ensure data transparency, which must be taken into account to ensure that LA tools are used appropriately at the institutional level.

Nevertheless, from the cross-analysis of all institutions data, we identified some common needs on Learning Analytics institutions. These needs are associated to existing processes in many universities and colleges, such as grading and tutoring, which provide a convenient starting point to start integrating data-driven strategies at an institutional level. It is important that institutions take into account the views of different stakeholders to contextualize our findings, in order to ensure that LA is implemented effectively and responsibly. Besides, the involvement of teaching staff and students is crucial to identify the need for LA services, and to evaluate if its adoption satisfies their requirements to use them in their everyday practices.

We believe that LA adoption is a promising opportunity to start a slow and incremental process with long lasting beneficial effects in terms of learning outcomes. From the perspective of students, teaching staff, and managers of Latin American Universities, LA is already perceived as a promising tool to improve quality feedback and to inform timely support interventions.

2.8- Applying the LALA Framework Workflow: exemplary cases

This section presents four exemplary cases showing how the four Latin American institutions applied the LALA Framework using the integrative workflow presented in Section 3.3.2. Both, the data collection procedures employed, and the main results are presented per institution in this section.

2.8.1. Data collection

To collect the data from the four Latin American institutions, we prepared a template with a matrix combining the four phases of the workflow (diagnostic, design/prototyping, piloting and scaling up) and the different dimensions of the LALA Framework. See an example of the matrix in Table 2-9 and the full documentation sent to each partner in ANNEX 5.

The matrix was delivered to the main representant of the LALA project in each Latin American Institution: Escuela Superior Politécnica, ESPOL (Ecuador), Universidad de Cuenca, UC (Ecuador), Pontificia Universidad Católica de Chile, PUC (Chili), and Universidad Austral de Chile, UACH (Chili). The representatives had to fill in the matrix following the instructions. Specifically, they had to indicate, for each phase of the workflow: (1) what dime**n**sion**s** of the LALA Framework they used, (2) what instruments of the dimension they adapted, (3) and other considerations including what stakeholders were involved, what processes were considered, what results were obtained, and the main challenges. Finally, they had also a box for including a brief explanation of the main challenges they experienced when applying the workflow and the LALA framework dimensions.

DIMENSIONS/ PHASES	Institutional		Technological		Ethical		Community		Other Considerations			
	Used?	Instruments	Used?	Instruments	Used?	Instruments	Used?	Instruments	Stakeholders	Processes	Results	Challenges
Diagnostic												
Design/Prototyping												.
Piloting												
Scaling up												
About the general process												

Table 2-9 Matrix used to collect data about how the Latin American institutions used the LALA framework workflow.

The templates fulfilled by the different institutions were collected by the Ponticia Universidad Católica de Chile. Two researchers were involved in the data collection process and provided a report of the main results that quantifies what are the main dimensions used in each phase, as well as the resources and instruments that were used (Section 9.2).

The case studies analyzed in each institution were the following:

- **Case 1: Adoption of NoteMyProgress in Pontificia Universidad Católica de Chile (PUC-Chile).** This university started in 2015 developing Massive Open Online Courses (MOOCs) and looking for new models to incorporate them as part of its regular programs. To support students in these new learning environments, the university launched an LA initiative to explore and support their self-regulatory abilities to deal with these new MOOC-based initiatives.
- **Case 2: Adoption of TrAC in Universidad Austral de Chile (UACh).** One of the main problems of the university are the dropout rates of the firsts years due to the socio-characteristics of their students. To deal with that, the institution has been working on the implementation of a LA solution for student academic counseling.
- **Case 3: Adoption of a redesigned Academic Counseling System in Escuela Politécnica del Litoral (ESPOL)**: This university has been working on the past years in a students' counseling tool for reducing dropout rates in the firsts years.
- **Case 4: Adoption of Dashboards in Universidad de Cuenca (UCuenca):** To deal with socio-economic differences among students, two LA dashboards have been introduced to provide teaching staff and counselors with information about students' curriculum progress and academic performance.

2.8.2. Results

This section presents a summary of the data collected per Latin American institution. Figure 2-13 shows a summary of the answers collected by the different partners.

		Institutiona	Technological	Ethical	Community	Instruments/Resources	Stakeholders	Results	Challenges
	ESPOL	1		1		LALA Canvas; Inverview Protocols; Consent forms	Teaching staff; Students; Institutional Leaders	Needs and requirements to improve current counseling system	Reaching teachers for the focus groups.
	UC	1		1		LALA Canvas; Inverview Protocols; Consent forms	Institutional Leaders (University President, Vice-Presidents; and IT Directors)	Report on the needs and requierements for a LA counseling process.	Get stakeolders involved (specially teachers and students)
	UACH	1		1		LALA Canvas; Inverview Protocols; Consent forms	Teaching staff; Students		
Diagnostic	PUC	1		1		LALA Canvas; Inverview Protocols; Consent forms	Teaching staff; Students	Report on the needs and requirements for a LA solution for MOOCs in Coursera	
	ESPOL		1	1		Technical Guidelines; Consent Forms	Teaching staff;	Report on improvement and usability.	ORLA was not employed. A Design process based on design thinking was used.
	UC	1		1		Technical Guidelines; Consent Forms	IT Department;	Data collected about thte tool usability and	ORLA was not employed. A Design process based on design thinking was
	UACH		1	1		Technical Guidelines; Consent Forms	IT Department;	Data collected about thte tool usability and improvements.	ORLA was not employed. A Design process based on design thinking was used.
Design/Prototyping	PUC		1	1		Technical Guidelines; Consent Forms	IT Department;	tool usability and improvements	process based on design thinking was used.
	ESPOL		1	1		Guidelines for the piloting provided by UaCh; Consent Forms	Teaching staff;	Feedback to improve the visualizations.	ORLA was not employed. A Design process based on design thinking was used.
	UC		1	1		Guidelines for the piloting provided by UaCh; Consent Forms	Teaching staff; Students; IT Department staff	Data collected about thte tool usability and improvements.	Cultural change.
	UACH		1	1	1	Guidelines for the piloting provided by UaCh; Consent Forms; LALA Community List of Members	Teaching staff; Students; IT Department staff		
Piloting	PUC		1	1	1	Guidelines for the piloting provided by UaCh; Consent Forms; LALA Community List of Members	Teaching staff; Students; IT Department staff	Data collected from the MOOCs and LA tool for measuring its impact.	
	ESPOL								This phase was not applied.
	UC	1		1		Interview protocols; Consent Forms	Institutional Leaders; IT Department staff	New project proposal for invovling three universities for piloting the tool.	Offering teaching and IT support for adapting the tool to the different courses and contexts.
	UACH	1		1		Interview protocols; Consent Forms	Teaching staff and students and IT staff		
Scaling up	PUC	1		1		Interview protocols; Consent Forms	Head if the Engineering Education Unit.		

Figure 2-13 Summary of the data collected from the different cases under study.

(1) Focus of the analysis

To identify similarities and differences across the four cases, we conducted a cross-case analysis focusing on two dimensions: 1) leadership processes to effectively involve diverse stakeholders in the adoption of LA tools, and 2) organizational maturity to analyze and act upon educational data. For that, we organized the different cases in a schema along these two dimensions (Figure 2-14).

The “Y” axis refers to the leadership processes. This axis indicates that institutions can have leadership processes between a top-down and bottom-up spectrum. This classification is inspired by the Complexity Leadership Theory (CLT) by Lichtenstein et al., (2006). Top-down processes refer to LA initiatives mainly led by high-level staff, such as managers or provosts, without involving necessarily ground-level staff such as teachers. On the contrary, bottom-up processes are commonly led by ground-level staff not involving stakeholders from higher levels.

In the “X” dimension we show the Organizational maturity. This axis is organized into five stages according to the concepts adopted from the LA sophistication model proposed by Siemens et al. (2013):

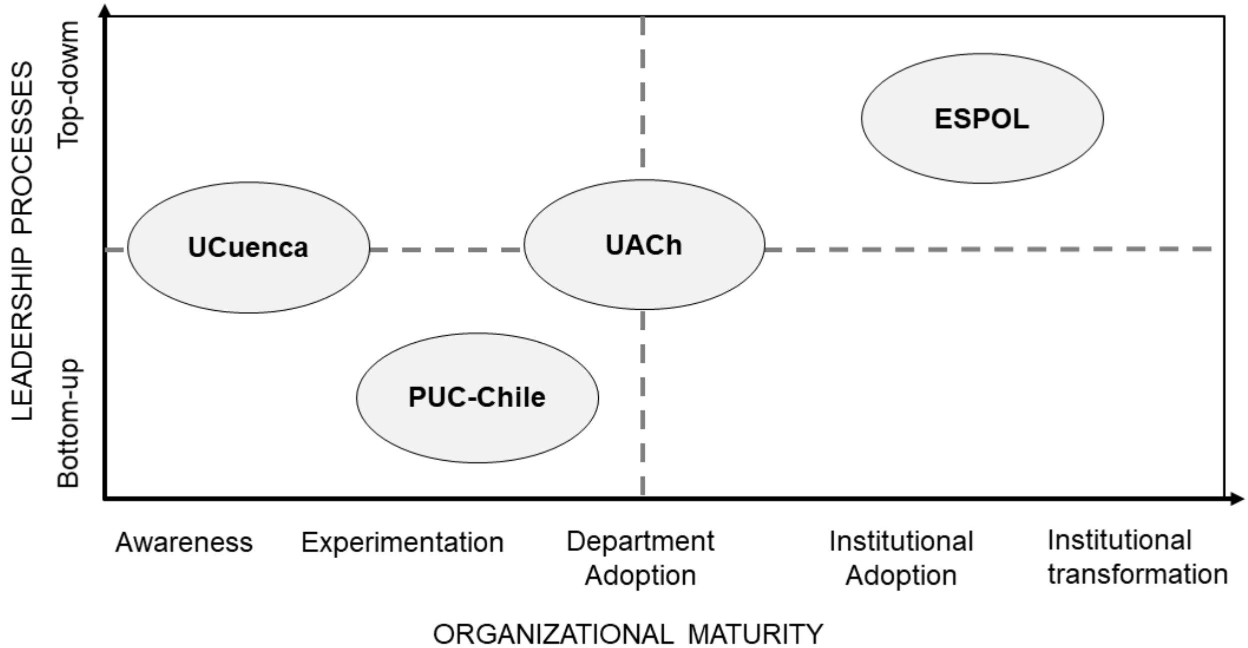
(1) awareness (basic understanding of LA tools and methods),
(2) experimentation (small-scale efforts for exploring how educational data could be used at a research or management level),

(3) department adoption (department efforts for integrating the use of educational data into staff and/or student practices),
(4) institutional adoption (institutional efforts for integrating analytical tools into staff and/or student practices),
(5) institutional transformation (institutional efforts for integrating analytical tools and evaluating its impact on student outcomes and learning and teaching practices).

Results from the cross-analysis

Regarding the **leadership processes**, the cross-analysis indicates that they involve stakeholders of different nature depending on the case. In the PUC-Chile case, for example, the LA initiative emerged from a researcher, which makes it a bottom-up leadership process. On the other side of the figure there is the case of ESPOL, which the LA initiative emerged as a top-down process led by the provost. In the PUC-case, some difficulties emerged when scaling up the initiative and passing from an experimental case to a more institutional support initiative. In the ESPOL case, the main difficulty was to assure the adoption and appropriation of the initiative by the grounded-level staff such as teachers. The UACh and UCuenca are more balanced cases, in which there is a combination of top-down and bottom-up leadership. In both cases, middle managers played crucial roles, acting as the bridge between high and grounded level staff.

Regarding the organizational maturity, the cross-analysis shows that it affected the leaders' capacity to incorporate the LA initiative as part of the existing institutional processes. The UCuenca, for example, was at the awareness level, which constrained the inclusion of the initiative at higher levels. On the other side, the PUC-Chile has already more experience managing and organizing educational data, so their maturity was higher. However, since the initiative was led by a grounded-level staff, scaling up was also challenging. Finally, the UACh and ESPOL had higher organizational maturity levels and, in both cases, the stakeholders involved were able to identify challenges in their academic counseling processes and transform it into an evidence-based practice by adopting the LA initiative.



2.9- Conclusions

2.9.1. About the LALA Framework

This document presented an update of the first LALA Framework, a framework that aims to provide guidelines to guide higher education institutions in Latin America in the design, implementation and adoption of learning analytics tools. The framework is composed of four different dimensions:

- the institutional dimension, which proposes a series of guidelines to understand and analyze the current state of a higher education institution in relation to the adoption of learning analytics;
- the technological dimension, a set of guidelines that provides an overview of the technological needs that an institution must consider for the adoption or implementation of a learning analytics tool;
- the ethical dimension, which provides a series of guidelines and sample forms on the aspects that an institution should consider in relation to the treatment and use of data for learning analytics projects; and
- the community dimension, which provides guidelines on how an institution or organization, as well as an individual researcher, can be integrated into the LALA community.

Each dimension are presented in a practical way, as a set of work plans with activities and resources, all accessible in the APPENDIX document.

The different dimensions can be used independently or jointly, according to the needs and interests of each institution.

- When institutions use the dimensions independently, they can make use of the activities and resources proposed to have a picture of certain aspects of their institution in relation to Learning

Analytics. For example, they can have a picture about what is the current state of their institution using the Institutional dimension, or they can prepare an institutional guideline for assuring an appropriate use for the data using the Ethical dimension.

- For using the dimensions jointly, we propose an integrative workflow organized into four phases: the diagnostic, the design/prototyping, the piloting and the scaling up. These phases are interconnected and can be applied sequentially and iteratively. In each of the phases, institutions can use the activities and the resources provided in each dimension of the LALA Framework, depending on their needs at every stage. As a preliminary evaluation of how this workflow is applied, we provided the example of the 4 Latin American partner institutions in the project.

2.9.2. Discussion and next steps

The LALA framework represents the first initiative that proposes a practical and step-by-step material to guide the design and/or adaptation of technological learning analytics solutions and processes for Latin American Higher Education Institutions. Although there are European initiatives with similar objectives, such as the SHEILA project or the document published by JISC in Great Britain in 2015, none of them propose a guideline format, based on previous studies, that considers all the necessary aspects to achieve a realistic and integrated adoption in Higher Education institutions. The LALA framework is, therefore, an initiative that provides a new vision on how to develop the adoption and installation capacities of learning analytics skills in higher education institutions.

The LALA framework presented in this document is a proposal that has been iterated along the three years of the project, but that can iterate continuously depending on its context of application**.** Below we present the future work:

(1) **Institutional dimension (ANNEX 1)**. Interviews and focus groups with the different institutions in the project, as well as with other institutions in Latin America were conducted in this dimensions. The objective was to offer an overview of the current state of learning analytics in Latin America. As a result of the analysis we identified the needs that institutions in Latin America have regarding LA. These needs could be taken as an starting point for other institutions, or as a reference for future research in the are. Also, during the three years of the project, adjustments have been made to the instruments developed. These instruments could serve also as reference for other institutions or researchers. Some of the results of this dimension have been validated by the research community and published in scientific journals (Hilliger et al, 2020a; Hilliger et al. 2020b; Hilliger et al., 2020c;Broos et al., 2020)

(2) **Technological dimension (ANNEX 2)**. The current manual offers a series of instruments that allow identifying the technological needs of an institution for the implementation of a learning analytics tool, as well as the requirements that it should have. This manual does not provide any specific guidelines on the most technical aspects to consider, from the design of the interfaces to the implementation and security of the databases. However, documents in this dimension should be read together with the deliverables about the “LA tools design” (https://www.lalaproject.org/wp-content/uploads/2019/04/Deliverable-WP3_Espa%C3%B1ol_Abril12.pdf), which explains the details about the desing and implementation process of the tools deployed in the project, and “Pilots”, which presents the lessons learned during the development and implementation of the

project's pilot tools. Therefore, the guidelines provided in this dimension, together with the examples from other deliverables could serve as a reference for other institutions that aim to implement their own LA solutions.

(3) **Ethical dimension (ANNEX 3).** Along the project, the project partners developed their data use forms and contracts. These documents, adapted to the needs of each of the countries involved, have already been made available in an open manner in the form of templates so that other institutions can use them as a reference. This is a first step towards the generation of a document sharing repository adapted to the regulations and laws of the different Latin American countries.

(4) **Community dimension (ANNEX 4)**. During the three years of the project, we attracted a total of 126 researchers and 83 institutions from Latin America and Europe, who join the community in order to learn and share their experiences in LA. Most of the institutions have actively partipated in the event organized during the project, and have shown their interest on helping continue the activities after the project. For example, we have already 4 candidates for organizing the next LALA Conference in 2022. In addition to that, and in order to ensure the continuity of the activities started during the project, the SOLAR Special Interest Group - LALA SIG was created in October 2020 (https://www.solaresearch.org/community/sigs/lala-sig/).This interest group is part of SoLAR, the Society for Learning Analytics Research, an international society that promotes research in the area of Learning Analytics. This interest group will receive financial support for its activities during two years after the end of the project in 2021. This ensures the sustainability of the activities related with LA in Latin America beyond the project.

In addition to the dimensions the two approaches for their application have been proposed. The first one proposes using the dimension documents and recommendations independently, depending on the needs fo the institution. The second approach proposes a 4-phase workflow: Diagnostic phase, Design/prototyping phase, Piloting phase and Scaling up. This workflow considers all the dimensions in an integrative manner and conceives the implementation and adoption of a LA solution as an iterative process that requires the orchestration of bottom-up leaderships with top-down leaderships. That is, this workflow considers that combining bottom and top down approaches is a good mechanism for LA initiatives that could potentially be completely integrated and in the institution and adopted by its stakeholders. captured through the Institutional and Ethical dimensions of the framework, or involving people related with the

How practitioners and/or researchers apply the two different approaches proposed is something that deserves further study and is beyond the objectives of the project. However, this could be a good starting point for analyzing other case studies of LA capacity building initiatives, and providing for examples to the LA community in Latin America.

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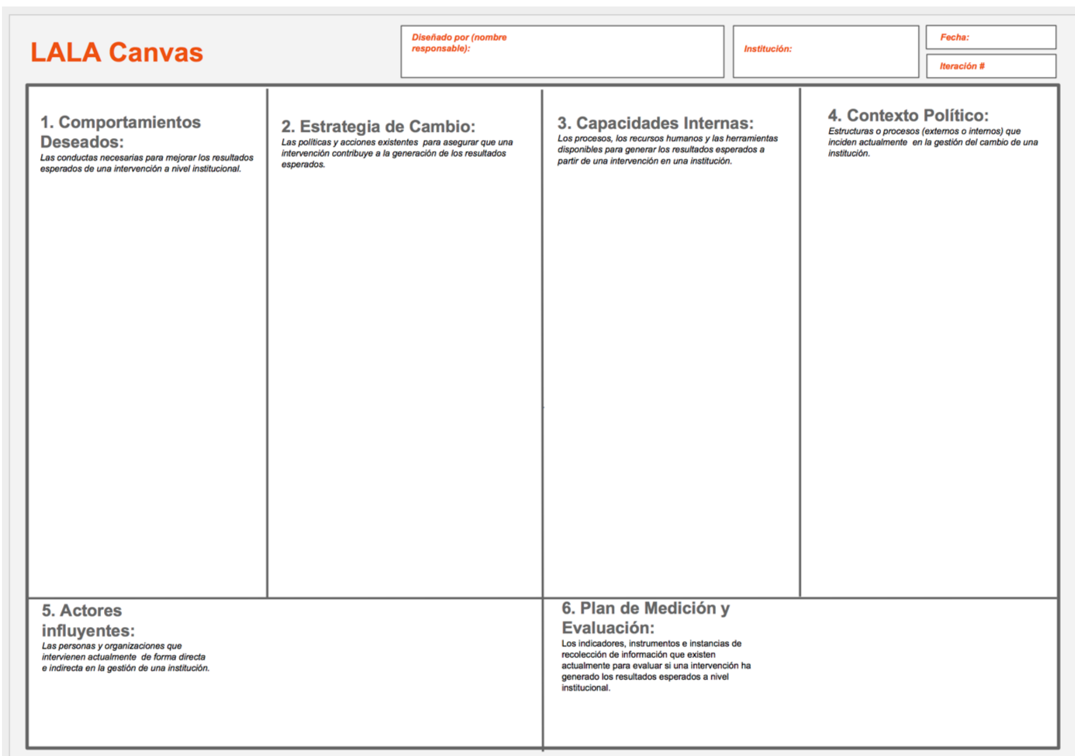
A1. APPENDIX INSTITUTIONAL DIMENSION

A1.1. LALA Canvas

The LALA Canvas is a template for guiding a group discussion about the current state of a higher education institution in terms of learning analytics.



A1.2. Interview Guidelines

Guidelines for interviewing different actors involved in the analysis for the institutional dimension.

Suggestions for the protocol application

- It is suggested to consider two people to lead each interview: a moderator (who asks the questions) and an observer (who takes notes).
- The moderator should be familiar with qualitative information collection methodologies.
- The time for the activity should be about an hour.
- The idea is to start by *framing* and ask for informed consent in writing.

Authorities	Academic staff	Students
<u>Methodology:</u> Snowball until obtaining redundant information (start with key actors and suggest that they refer someone else to talk to). <u>Number of participants:</u> At least one (unless the authority decides to add more). <u>Examples of key players:</u> • Vice Chancellor • Deans/Teaching Directors • Deans of faculties • Career Coordinators • Student welfare • Director of Information Technology	<u>Methodology:</u> Sampling by convenience in different Faculties relevant for the institution (ideally at least one per faculty) <u>Number of participants:</u> At least three (it is suggested citing six to eight people).	<u>Methodology:</u> Sampling by convenience in different Faculties relevant for the institution (ideally at least one per faculty) <u>Number of participants:</u> At least three (it is suggested citing six to eight people).

General framing

The learning analytics involves the collection and analysis of educational data, such as grades and class attendance, with the objective of obtaining information on how students approach their studies and implementing services to improve their learning processes. For example, alert systems can be developed to offer support to students who are at risk of failing a course or abandoning their studies. Systems that analyze the hours invested by a student in an online or face-to-face learning environment can also be developed, to determine the time spent on a course or module. In this way, the use of educational data in services based on learning analytics provides information to identify any type of problem that may affect the learning process of a student.

Taking into account that [your management/ your teaching/your learning] can benefit from the use of educational data, it is very important to consider your opinions and expectations during the design and implementation of the different services. For this purpose, you have been invited to participate in this interview that will last approximately one hour. Its objective is to get to know your opinion about the use of your educational data by the university, and your expectations about the services that could be developed from this data.

The information collected in this interview will be used to inform about the development of policies associated with the use of educational data in different Latin American universities through the European LALA project, which is a collaborative project funded by the European Commission. This interview will be recorded but this recording may be interrupted at any time a participant requests it.

[Authorizing signature]

1.- Warm-up

AUTHORITIES	ACADEMIC STAFF		STUDENTS
1. Mention the position you currently hold and years of experience.	1. Mention the position you hold, the faculty/ school you belong to and years of experience.		1. Mention the career you are pursuing and in what semester/year you are currently.
2. What data is relevant to understand how students and teachers are performing?	2a. What data is relevant to understand how your students are performing in their studies?	2b. What data is relevant to understand how you are doing *as a professor*?	2. What data is relevant for you to know how you are doing in your studies?
3. What data is provided to students and teachers to give feedback on their performance? How effective is it?	3a. What data do you provide to students to give feedback on their academic performance? How effective is it?	3b. What data does the institution provide to give feedback on your teaching performance? How effective is it?	3. What data do the teachers and the institution provide to give you feedback on your academic performance? How effective is it?

2- Exploring discussion points

Topic: Transparency, ethics and data privacy

AUTHORITIES	ACADEMIC STAFF		STUDENTS
4. What types of data does the university collect about students and academic staff?	4a. What types of data do you think the university has been collecting about you?	4b. What types of data do you think the university has been collecting about students?	4. What types of data do you think the university has been collecting about you?
5. Do academic staff and students sign any consent forms where they are told that their data will be used? When?	5a. Have you signed any consent form where you were told that your data will be used? When??	5b. Do you know if the students have signed a consent form where they are told their data will be used? When?	5. Have you signed any consent form where you are told that your data will be used? When?
6. Are there policies available on how the university collects and analyzes the data of academic staff and students??	6a. Are there policies available about how the university collects and analyzes your data and that of your students??	6b. Do you know if students are informed about the way the university collects and analyzes their data?	6. Is there clear information available about how the university collects and analyzes your data?
7. Is there a policy to determine who has access to the data that the university collects about students and academic staff? Who has access to the data?	7a. Do you know who has access to your data? Who should be granted the right to access your data? Should you be informed about who can access your data?	7b. Do you know who has access to student data? Who should be granted the right to access their data? Should you be informed about who can access their data?	7. Do you know who has access to your data? Who should be granted the right to access your data? Should you be informed about who can access your data?
8. Is there some type of data for which the university should explicitly ask for academic staff' and students' consent (for	8a. Is there some type of data for which the university should explicitly ask for your consent (for example, data	8b. Is there some type of data for which the university should explicitly ask for the students' consent (for	8. Is there some type of data for which the university should explicitly ask for your consent (for example, data about your religious beliefs)?

<table>
<tr><td>example, data about their religious beliefs)?</td><td>about your religious beliefs)?</td><td>example, data about their religious beliefs)?</td><td></td></tr>
<tr><td colspan="4">Topic: Academic Use of Data</td></tr>
<tr><td>Authorities</td><td colspan="2">Academic staff</td><td>Students</td></tr>
<tr><td>9. What use does the institution give to the data collected from students and academic staff to improve their academic and teaching performance? Examples?</td><td colspan="2">9. These are some examples of the use of data to help students in their learning. Which of these examples would you prefer to implement? Organize them in order of importance.
a. Improving the advice they receive from the academic staff or with the academic tutors.
b. Improving their learning experience as a whole, and their well-being.
c. Detecting weak points in their learning and suggesting ways to improve it.
d. Alerting the academic staff as soon as possible, if tthey are at risk of failing a module, course), or if they could improve their learning.
e. Identifying, based on their curriculum, the optimal path for their studies (for example, suggesting optional subjects).
f. Offering them their complete learning profile in each module.</td><td>9. These are some examples of the use of your data to help you learn. Which of these examples would you prefer to implement? Organize them in order of importance.
a. Improving the advice you receive from the academic staff or with the academic tutors.
b. Improving your learning experience as a whole, and your well-being.
c. Detecting weak points in your learning and suggesting ways to improve it.
d. Alerting the academic staff as soon as possible, if you are at risk of failing a module, course), or if you could improve your learning.
e. Identifying, based on your curriculum, the optimal path for your studies (for example, suggesting optional subjects).
f. Offering you your complete learning profile in each module</td></tr>
<tr><td>10/11 How else could student and professor data be used to improve understanding of their academic and teaching</td><td colspan="2">10. How else could student data be used to improve understanding of their academic performance at the university?</td><td>10. How else could your data be used to improve understanding of your</td></tr>
</table>

performance at the university??		academic performance at the university??
	11. How could the data you get from students be used to improve understanding of your teaching practice at the university?	11. How could the data you get from the teachers be used to improve the understanding of your performance at the university?
Topic: Data Feedback		
Authorities	*Academic staff*	*Students*
12. What would be the best way to show the results of the educational data analysis?	12. What would be the best way to show the results of the educational data analysis? (academic staff and students)	12. How would you like to receive the results of the analysis of your educational data? a. In person (for example, from your academic tutor). b. As a text (for example, by email). c. Through visualizations (for example, through a graphic interface in a software tool). d. Of these three options, which one do you think is the most useful for your learning?
13. How often should the results be sent? For example, every day, once a week, etc.	13. How often would you like to receive the results? For example, every day, once a week, etc. (*academic staff and students)*	13. How often would you like to receive the results? For example, every day, once a week, etc.
14. Should the results include a comparison of the professor's/student's progress with respect to	14. Should the results include a comparison of your progress with respect to the progress of the rest of your colleagues?	14. Should the results include a comparison of your progress with respect to the progress of

the progress of the rest of their colleagues?			the rest of your classmates?
Topic: Intervention based on results			
Authorities	Academic staff		Students
15. How are the results of academic staff' and students' data approached? What actions are taken? What actions should be taken?	15. How are the results of your data approached? What actions are taken? What actions should be taken?	15. How are the results of students' data approached? What actions are taken? What actions should be taken?	15. How do they approach the results of your data? What actions are taken? What actions should be taken? How should the institution approach the analysis of your data? a. Should they have an obligation to act if they detect that you are at risk of failing a module, or if they detect that you have low performance in a module? b. Should the academic staff receive some type of training to understand the analysis of your educational data, and to provide you with results that are useful? c. Should the university offer students the possibility to refuse the support?

3.- Closing activities

AUTHORITIES	ACADEMIC STAFF	STUDENTS
16. Is there any additional information that would be important to obtain from students and academic staff? Why?	16. Is there any additional information that would be important to obtain from students and you? Why?	16. Is there any additional information that would be important to obtain academic staff and you? Why?

17. Would you like to add anything else?

A1.3. Questionnaire format to be used with professors

Format of the questionnaire used to ask academic staff about the institutional aspects of data use.

LALA
Learning Analytics in Latin America

Academic staff's expectations about the use of educational data

Different higher education institutions have implemented services to support the learning process of their students from the collection and analysis of different educational data, such as grades, class attendance, or access to electronic resources (i.e. a alert system for students who are at risk of failing a subject).

In this context, the purpose of this survey is to get to know the opinion of a university's academic staff about the collection and analysis of educational data in their institution. Answering the survey takes approximately 10 minutes and your participation is voluntary.

The following statements describe situations that could occur in the future given the progress of research on the use of educational data in higher education institutions. For each of the statements, indicate the degree of agreement or disagreement by marking an option from 1 to 7 on each scale, where 1 indicates disagreement and 7 indicates agreement.

A set of questions represents whether you would like what is described in the statement to happen at your university. Note: If what is described in the statement is something that you consider highly desirable, select the maximum value on the scale (7).

Another set of questions represents your perception of what could actually happen at your institution (in relation to what is described in the statement). Note: If the description in the statement is something already implemented at your institution or you think it is highly likely to happen, select the maximum value on the scale (7).

The results of the survey will be used to develop policies associated with the collection and analysis of educational data at different Latin American universities through the project *Building Capacity to Use Learning Analytics to Improve Higher Education in Latin America (LALA)* (https://lalaproject.org/), which is financed by the European Commission and has Latin American and European universities participating. Your answers will be anonymous and will only be disclosed at the aggregate level.

Please, check the box to confirm that you have read the previous information.

CHARACTERIZATION

Gender	Male	Female
Years of teaching experience		
Faculty (Check <u>one</u> option)	Agronomy and Forestry Engineering	
	Architecture, Design and Urban Studies	
	Arts	
	Biological Sciences	
	Economic and Administrative Sciences	
	Social Sciences	
	Communications	
	Literary Arts	
	Law	
	Education	
	Philosophy	
	Physics	
	History, Geography and Political Science	
	Engineering	
	Mathematics	
	Medicine	
	Chemistry	
	Theology	
Academic category	Assistant Professor	
	Deputy Assistant Professor	

	Associate Professor	
	Adjunct Associate Professor	
	Tenured Professor	
	Attached Titular Professor	
Management position	Chair of Undergraduate Program	
	Chair of Postgraduate Program	
	Chair of Research Program	
	Dean	
	Director at the level of Vice-chancellor	
	Vice-Chancellor	
	Other	
	Does not apply	
Chilean or international professor? (check one option)	Chilean	
	International	

ACADEMIC STAFF'S EXPECTATIONS ABOUT THE USE OF EDUCATIONAL DATA

1. The university will provide me with a manual on how to access the analysis of my students' educational data.

Ideally, I would like it to happen — I think it can actually happen

I disagree — I agree — I disagree — I agree

1	2	3	4	5	6	7

1	2	3	4	5	6	7

1. The university will provide the academic staff with opportunities for professional development in the use of educational data for teaching.

Ideally, I would like it to happen / I think it can actually happen

I disagree — I agree / I disagree — I agree

1	2	3	4	5	6	7

1	2	3	4	5	6	7

1. The university will facilitate open discussions in which the experiences related to the services associated with the use of educational data can be shared.

Ideally, I would like it to happen / I think it can actually happen

I disagree — I agree / I disagree — I agree

1	2	3	4	5	6	7

1	2	3	4	5	6	7

1. I will be able to access the data related to my students' progress, in any of the courses in which I am teaching or providing tutoring services.

Ideally, I would like it to happen / I think it can actually happen

I disagree — I agree / I disagree — I agree

1	2	3	4	5	6	7

1	2	3	4	5	6	7

1. I will be able to access the data of any student who is in a program.

Ideally, I would like it to happen / I think it can actually happen

I disagree I agree I disagree I agree

1	2	3	4	5	6	7

1	2	3	4	5	6	7

1. The services related to the use of educational data will allow students to make their own decisions based on the information provided.

Ideally, I would like it to happen I think it can actually happen

I disagree I agree I disagree I agree

1	2	3	4	5	6	7

1	2	3	4	5	6	7

1. The university will provide support to the student as soon as possible (for example, advice from the tutor) if the analysis of the student's educational data suggests that they may be having some difficulty or problem (for example, if the student is found to have poor performance, or a high risk of dropping the course).

Ideally, I would like it to happen I think it can actually happen

I disagree I agree I disagree I agree

1	2	3	4	5	6	7

1	2	3	4	5	6	7

1. The university will regularly inform the students about their educational progress, based on the analysis of their educational data.

Ideally, I would like it to happen I think it can actually happen

I disagree I agree I disagree I agree

1	2	3	4	5	6	7

1	2	3	4	5	6	7

1. The services related to the use of educational data will collect and show accurate data (error-free data, for example, data without erroneous evaluation results).

Ideally, I would like it to happen | I think it can actually happen

I disagree | I agree | I disagree | I agree

1	2	3	4	5	6	7		1	2	3	4	5	6	7

1. The services related to the use of educational data will show a comparison between the student's progress in their learning and the learning objectives of their courses.

Ideally, I would like it to happen | I think it can actually happen

I disagree | I agree | I disagree | I agree

1	2	3	4	5	6	7		1	2	3	4	5	6	7

1. The information provided by the services related to the use of educational data will be displayed in an understandable and easy-to-read format.

Ideally, I would like it to happen | I think it can actually happen

I disagree | I agree | I disagree | I agree

1	2	3	4	5	6	7		1	2	3	4	5	6	7

1. The services related to the use of educational data will show students a complete profile of their learning in each of their courses (for example, number of accesses to online materials, attendance data or results obtained).

Ideally, I would like it to happen | I think it can actually happen

I disagree | I agree | I disagree | I agree

1	2	3	4	5	6	7

1	2	3	4	5	6	7

1. The academic staff will be able to incorporate the results obtained through the analysis of the educational data in the information and support that they provide to the students.

Ideally, I would like it to happen | I think it can actually happen

I disagree | I agree | I disagree | I agree

1	2	3	4	5	6	7

1	2	3	4	5	6	7

1. The academic staff will have the obligation to support the students if the analysis of the student's educational data shows that they have a low performance, that they are at risk of suspension, or that they can improve their learning.

Ideally, I would like it to happen | I think it can actually happen

I disagree | I agree | I disagree | I agree

1	2	3	4	5	6	7

1	2	3	4	5	6	7

1. The information obtained through the services related to the use of educational data will be used to promote the development of students' academic and professional skills for future employability (for example, effective communication).

Ideally, I would like it to happen							I think it can actually happen						
I disagree						I agree	I disagree						I agree
1	2	3	4	5	6	7	1	2	3	4	5	6	7

1. The analysis of educational data will allow me to better understand the learning process of my students and their academic results.

Ideally, I would like it to happen							I think it can actually happen						
I disagree						I agree	I disagree						I agree
1	2	3	4	5	6	7	1	2	3	4	5	6	7

A1.4. Questionnaire Format to be applied to students

Format of the questionnaire used to ask students about the institutional aspects of data use.

Students' expectations about the use of educational data

Different higher education institutions have implemented support services for the learning process of their students from the collection and analysis of different educational data, such as grades, class attendance, or access to electronic resources (i.e. an alert system for students who are at risk of failing a course).

In this context, the purpose of this survey is to get to know the students' opinion about the collection and analysis of educational data in their institution. Answering the survey takes approximately 5 minutes and your participation is voluntary.

The following statements describe situations that could occur in the future given the progress of research on the use of educational data in higher education institutions. For each of the statements, indicate the degree of agreement or disagreement by marking an option from 1 to 7 on each scale, where 1 indicates disagreement and 7 indicates agreement.

A set of questions represents whether you would like what is described in the statement to happen at your university. Note: If what is described in the statement is something that you consider highly desirable, select the maximum value on the scale (7).

Another set of questions represents your perception of what could actually happen at your institution (in relation to what is described in the statement). Note: If the description in the statement is something already implemented at your institution or you think it is highly likely to happen, select the maximum value on the scale (7).

The results of the survey will be used to develop policies associated with the collection and analysis of educational data at different Latin American universities through the project *Building Capacity to Use Learning Analytics to Improve Higher Education in Latin America (LALA)* (https://lalaproject.org/), which is financed by the European Commission and has Latin American and European universities participating. Your answers will be anonymous and will only be disclosed at the aggregate level.

Please, check the box to confirm that you have read previous information.

Characterization

Place of residence before starting your university studies:			
Gender	**Male**	**Female**	**I prefer not to respond.**
Age			
At what Faculty are you studying? (Check <u>one</u> option)	**Agronomy and Forestry Engineering**		
	Architecture, Design and Urban Studies		
	Arts		
	Biological Sciences		
	Economic and Administrative Sciences		
	Social Sciences		
	Communications		
	Literary Arts		
	Law		
	Education		
	Philosophy		
	Physics		
	History, Geography and Political Science		
	Engineering		
	Mathematics		
	Medicine		
	Chemistry		

	Theology	
What degree are you studying for? (check one option)	**Undergraduate**	
	Master's	
	Doctorate	
Chilean or international student? (check one option)	**Chilean**	
	International	

EXPECTATIONS ON THE USE OF EDUCATIONAL DATA AT MY UNIVERSITY

1. The university will request my consent before using any personal data (for example, ethnicity, age or gender).

Ideally, I would like it to happen — I think it can actually happen

I disagree — I agree — I disagree — I agree

1	2	3	4	5	6	7	1	2	3	4	5	6	7

1. The university will make sure to keep my educational data safe.

Ideally, I would like it to happen — I think it can actually happen

I disagree — I agree — I disagree — I agree

1	2	3	4	5	6	7	1	2	3	4	5	6	7

1. The university will request my consent before sharing my educational data with other institutions or companies.

Ideally, I would like it to happen							I think it can actually happen						
I disagree						I agree	I disagree						I agree
1	2	3	4	5	6	7	1	2	3	4	5	6	7

1. The university will inform me regularly about the progress of my learning, based on the analysis of my educational data.

Ideally, I would like it to happen							I think it can actually happen						
I disagree						I agree	I disagree						I agree
1	2	3	4	5	6	7	1	2	3	4	5	6	7

1. The university will request my consent to collect, use and analyze any of my educational data (for example, grades, attendance data or access to e-learning environments).

Ideally, I would like it to happen							I think it can actually happen						
I disagree						I agree	I disagree						I agree
1	2	3	4	5	6	7	1	2	3	4	5	6	7

1. The university will request a new consent if my educational data will be used for a purpose other than the original one.

Ideally, I would like to happen							I think it can actually happen						
I disagree						I agree	I disagree						I agree
1	2	3	4	5	6	7	1	2	3	4	5	6	7

1. The services related to the use of educational data will be used to promote students' decision-making (for example, by encouraging the student to adjust their own learning objectives through the feedback information provided to them).

Ideally, I would like it to happen							I think it can actually happen						
I disagree						I agree	I disagree						I agree
1	2	3	4	5	6	7	1	2	3	4	5	6	7

1. The services related to the use of educational data will compare my progress to my learning objectives or to the objectives of my courses.

Ideally, I would like it to happen							I think it can actually happen						
I disagree						I agree	I disagree						I agree
1	2	3	4	5	6	7	1	2	3	4	5	6	7

1. The services related to the use of educational data will show me a complete profile of my learning in the courses (for example, number of accesses to an electronic resource or attendance data).

Ideally, I would like to happen | I think it can actually happen

I disagree | I agree | I disagree | I agree

1	2	3	4	5	6	7	1	2	3	4	5	6	7

1. The academic staff will be able to provide me with information and support based on the results obtained through the analysis of my educational data.

Ideally, I would like to happen | I think it can actually happen

I disagree | I agree | I disagree | I agree

1	2	3	4	5	6	7	1	2	3	4	5	6	7

1. The academic staff will have the obligation to support me if the results obtained from the analysis of my educational data show that my performance is below average, that I am at risk of being suspended, or that I can improve my learning.

Ideally, I would like to happen | I think it can actually happen

I disagree | I agree | I disagree | I agree

1	2	3	4	5	6	7	1	2	3	4	5	6	7

1. The information obtained through the services related with the use of my educational data will be used to promote the development of academic and professional skills for my future employability (for example, effective communication).

Ideally, I would like to happen | I think it can actually happen

I disagree | I agree | I disagree | I agree

1	2	3	4	5	6	7

1	2	3	4	5	6	7

A1.5. Format of the questionnaire to be applied to students

This template allows to document the expected status from the adoption of a learning analytics tool. Please complete the following Table with the information previously collected through the application of LALA Canvas, interviews with key actors and online questionnaires for professors and students.

Institution	
• Team that participated in the Template	
Needs that require adopting a learning analytics tool	
•	
•	
•	
Considerations for adopting a tool	
• Technological	
• Ethical	

A2. APPENDIX TECHNOLOGICAL DIMENSION

A2.1. OrLA Design Requirements Guide

The OrLA Design Guide aims to identify key design requirements by institutional leaders or managers, researchers and professors that the learning analytics technology solution should include to meet the needs identified at the institutional level.

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Desarrolladores, comenzad aquí...				
Nombre de la herramienta (de analitica de aprendizaje) →				
Breve descripción →				
Propósito y beneficios				
Propósito de la herramienta →				
Beneficios de la herramienta para el aprendizaje →				
Otros beneficios de la herramienta →				
Pre-requisitos y presunciones de la herramienta (en términos de habilidad tecnológica del docente o los alumnos, capacidad para				
Functionalities				
Actividades docentes \ Soporte	**Cómo soporta la herramienta esta actividad, o el aprendizaje durante esta fase? ↓**	**Quién usa la herramienta en esta fase? (aprendices, docentes, padres, administración...) ↓**	**Cómo se usa la herramienta en esta fase? (Qué acciones deben tomar los usuarios con la herramienta) ↓**	**Cuánto tiempo lleva usar la herramienta en esta fase? ↓**
Diseño/Planificación/Preparación de las actividades de aprendizaje →				
Gestión de las actividades y adaptación en caso de eventos inesperados →				
Seguimiento del proceso de aprendizaje y evaluación del aprendizaje →				
Reflexión posterior sobre el éxito of fracaso de las actividades de aprendizaje (p.ej., para futuros cursos) →				
Herramientas alternativas				
Existen ya herramientas comparables? Cuáles? →				
En qué aspectos es la herramienta mejor que las alternativas? →				
En qué aspectos es la herramienta peor que las alternativas? →				
Qué soporte adicional existe para el uso de la herramienta? (ayuda en línea, formación, soporte técnico, ...) →				
Disciplina, ética y privacidad				
Cómo saben los usuarios qué tipo de datos se están recogiendo y procesando en la herramienta? →				
Cómo saben los usuarios qué tipo de procesado de datos se han usado para generar las representaciones de datos mostradas en la herramienta? →				
Cómo se puede validar la exactitud o fiabilidad de los algoritmos/procesado utilizados en la herramienta? →				
Quién es responsable de interpretar los datos y chequear la validez de la información proporcionada por la herramienta? →				
Dónde se almacenan los datos de la herramienta? (ya sean datos de estudiantes, datos personales, etc.) →				
Cómo pueden los estudiantes (u otros actores) hacer mal uso de la herramienta? →				
Comentarios de investigadores				
Está la herramienta alineada con las presunciones pedagógicas/teóricas de la innovación que tienes en mente? →				
Otros comentarios a raíz de las respuestas proporcionadas arriba →				

Comentarios del docente		
Las representaciones de datos te resultan claras? ↓	**Sabrías qué acciones tomar cuando veas este tipo de análisis? ↓**	**Conoces otros docentes que han usado la herramienta, recomiendan su uso o lo desaconsejan? ↓**
Tienen estos propósitos y	Te suena fácil de utilizar? [score 1-5, add	Te ves a tí mism@ usando esto en tu
Tiene este tipo de soporte valor para tí? [puntúa 1-5, añade comentarios si fuera necesario] ↓	Implica este tipo de uso de la herramienta cambios en tu práctica docente actual? [puntúa 1-5, añade comentarios si fuera necesario] ↓	Tienes esta cantidad de tiempo disponible en tu práctica docente habitual? [Sí/No, añade comentarios si fuera necesario] ↓
Te parece que esto es útil? [puntúa 1-5, añade comentarios si	**Qué otros indicadores y datos te gustaría tener? ↓**	**Qué otras funcionalidades te gustaría tener en una herramienta de este tipo?**
Te parece esto aceptable en tu contexto de clase concreto? [Sí/No, añade comentarios si fuera necesario] ↓		

A2.2. Technical considerations guide

The OrLA Design Guide aims to identify key design requirements by institutional leaders or managers, researchers and professors that the learning analytics technology solution should include to meet the needs identified at the institutional level.

Technical considerations guide for the development and implementation/adaptation of the tool

The technical manual is a guide on the technical considerations that should be taken into account for the installation/adaptation of a Learning Analytics tool in my institution. In this guide we analyze the technical requirements from 4 dimensions (Figure 1): (1) the required hardware, (2) required software, (3) technical personnel and (4) data sources. When you finish reading the manual and answer the questions in each section, you will have a notion of what types of data the tool uses, how to access the data, how the data is managed, the equipment required to collect and store the data, personnel required for the implementation and the necessary software to complement the tool.

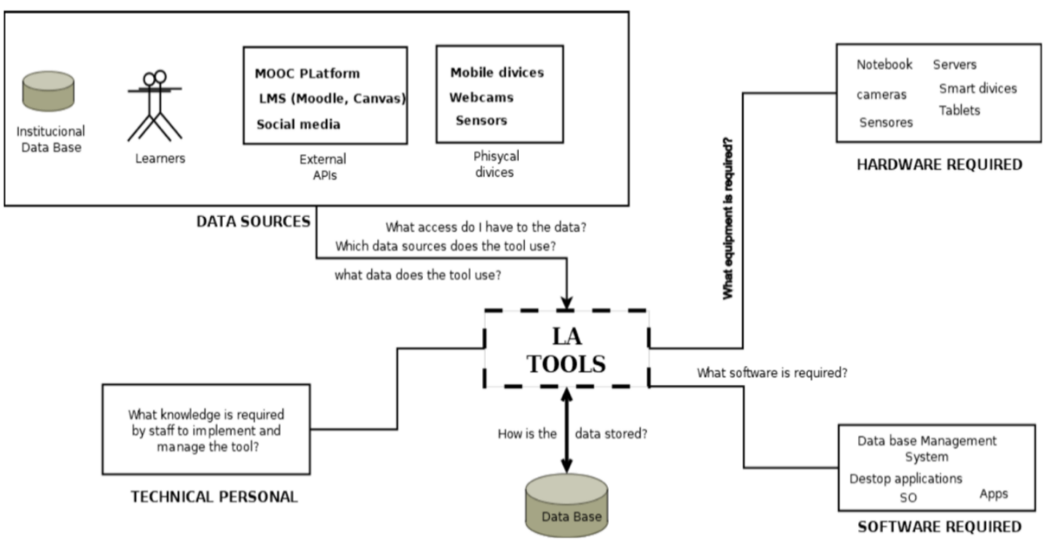


Figure 1. Dimensions to be considered for the implementation of the tool

How does the manual work?

During your progress through the manual you will find a series of questions related to the 4 dimensions defined for the implementation. You must follow the sequence of asking and answering each of them based on the information for the tool you wish to implement. If you do not have the information required to answer some of the questions, it is necessary to find that information before starting the implementation of the tool. The questions are adjustable to any type of tool that you want to implement, so you should be able to answer all the questions.

The first step to be done for the process of implementing the tool is to identify the sources of information offered by the tool. For that purpose, we answer the following questions:

1. What is the official site or URL that provides information about the tool?
2. What link or repository is available to download the tool?
3. Who owns the tool or the rights for the development of the tool?
4. Who is the person in charge of providing technical support for the tool and their contact?

The following steps are intended for the analysis of each of the dimensions.

1. Data and data source dimension

The objective of this dimension is to analyze information about the data used by the tool. The tools for learning analytics base their purpose on the monitoring, analysis and reporting of data to the different actors that use the tool (Professors, students, administrative staff, technicians). For this reason, this dimension is the first to be analyzed in the implementation of the tool. In this dimension a series of questions are proposed that must be established before starting the development/implementation or adaptation of the selected tool.

Question	Instructions
a. What data does the tool need to be implemented?	The first is to get to know what data the tool uses, for example, students' personal information, grades obtained, evaluations, information about professors, courses, schedules, geographical location of users, among others.
b. What is the source of data that the tool uses?	Once the data is identified, we must analyze the source or sources of the data that the tool uses, that is, where the required data come from. As shown in Figure 1, the system can use the information stored in the institutional database, information collected by physical devices such as sensors or cameras, information collected by other applications such as MOOC or LMS platforms. On the other hand, the source of information may be the users themselves or the log files that the tool registers.
c. Who manages access to the required data?	Once the data source is located, we must know who manages the required data. This case applies mainly when the data source is an external application or the institutional database. MOOCs platforms, for example, may require a procedure to request access to the data, in which case we must know who the person of our institution with privileges to request the data is. In the case of the institutional data bases we must know who is in charge of the database and what procedures are required to access the data.
d. What are the characteristics of the data?	Once we have access to the data, we must analyze the characteristics of the data, both at the source of origin and at the database used by the tool. At this point we analyze the model of data used at both extremes, data structure, data types, relationships among the data, etc.

e. Where is the data managed by the tool stored?	The next step is to know where the tool will store the data, database type, physical location (local server, remote server, in the cloud).
f. How is the data integrated into the tool?	The integration of the data is the process that is highly relevant for the implementation. The tool to be implemented can be developed to make a direct connection to the data source. However, a configuration process that allows you to integrate the data source with the tool (address or domain of the source, user, password) is always required. In other cases, the use of scripts that are responsible for the extraction, cleaning, transformation and storage of data is required. It is necessary to be clear if the integration of the data is an automated process, or it is necessary to perform a manual process that is executed periodically, such as, for example, downloading the reports from the platform and then executing the scripts manually to update the data.
g. How are these data manipulated?	Once the data is stored, we must be sure how we can manipulate the data. That is, whether the tool provides features for the data manipulation or the development of scripts is required to manipulate the data.
h. Who manages the data that the tool handles?	Then it is necessary to define who will be the person or people in charge of the management of the data that the tool handles. They will be responsible for executing the tool integration scripts and the periodicity, among other management activities.
i. Who will have the access to the tool data and for what purpose?	In addition to the end users of the tool, who will have the access to the stored data and for which purpose.

2. Hardware Dimension

The objective of this dimension is to analyze what equipment is required for the implementation of the tool. In this dimension you should consider the questions in the following table.

Question	Instructions
a. What are the characteristics of the equipment required to install the tool?	Regarding the hardware, the first thing to know is what technical specifications the equipment where the tool will be installed (memory, disk capacity, processing capacity) requires.
b. Does the database require an additional server?	The next step is to know if the database uses the same equipment or requires additional equipment.

c. Where will the equipment where the tool is installed be located?	Then you should consider the physical space that the equipment requires. We must know if we have a space to locate the equipment, if the equipment needs to be connected to the institutional network in the server room. In addition, we must ask ourselves what type of access we have to those spaces.
d. Is it necessary to acquire additional equipment for the operation of the tool, for example, tablets?	Some tools can use data sources such as mobile devices, sensors, cameras, microphones, among others. It is also necessary to make a list of the required equipment. Analyze which of those the institution already has, which ones should be acquired and the budget available to acquire the equipment.
e. What equipment is required for the maintenance and administration of the tool?	Finally, the equipment required for the administration of the tool, such as personal computers, PCs, tablets, among others, should be considered.

3. Software Dimension

The objective of this dimension is to analyze what software is required for the implementation of the tool. In this dimension you should consider the questions in the following table.

Question	Instructions
a. In which programming language is the tool developed?	The first step is to know the technology used for the development of the tool, programming language, version, libraries that the tool uses, required applications, among others.
b. What operating system do I need to install the tool?	Then, we must know in which operating system the tool works, version of the operating system and its compatibility with other versions.
c. What database management system does the tool require?	The next step is to know which database management system the tool uses (MySQL, PostgreSQL, SQL Server, Mongo, among others).
d. What extra applications need to be installed for the operation of the tool?	Then it is necessary to analyze what additional applications need to be installed for the administration and configuration of the extra equipment that the tool can use (sensor control system, cameras, Smart devices)
e. What type of licensing does the tool require??	Finally, analyze the type of licensing defined for the tool we wish to implement, and the type of licensing of the other applications used.

4. Technical personnel dimension

The objective of this dimension is to analyze what knowledge should the technical personnel in charge of the implementation and administration of the tool have. In this dimension you should consider the questions in the following table.

Question	Instructions
a. What knowledge does the technical personnel need to perform the installation and configuration of the tool?	The technical personnel that must perform the implementation and/or adaptation of the tool must have previous knowledge about the tool to be used. In some cases, it may be necessary to meet for a technical specialization course.
b. What knowledge does the personnel that will maintain the tool require?	It is essential that the technical personnel is familiar with the steps necessary for the maintenance and updating of the tool. For this, it is important to have the use and maintenance manuals.

A2.3. Evaluation and testing guide

This guide aims to create awareness about the elements that must be taken into account to perform the tool's pilot tests. The guide is presented as a checklist to ensure that the most relevant variables for the tool's pilot tests have been considered.

Guide on considerations for the design of the procedure for evaluation and testing of the tool

This guide aims to create awareness about the elements that must be taken into account to perform the tool's pilot tests. The guide is presented as a checklist to ensure that the most relevant variables for the tool's pilot tests have been considered.

Types of evaluations to be considered in the pilot test

• Tests were defined to ensure the quality and validity of the data presented by the tool.

• Tests were defined to evaluate the correct functioning of the tool (test cases, data entry, incompatibility with other existing tools, among others).

• System tests were defined to evaluate the performance of the tool (memory consumption, response time, concurrency, among others).

• Tests were defined to evaluate the usability and usefulness of the tool in the real environment where it will be implemented (Ease of use of the tool, importance of the presented information, interpretation of the data by the stakeholders).

• Tests were defined to evaluate the adoption of the tool by stakeholders (How stakeholders use the tool, frequency of use, with what objective).

• Tests were defined to evaluate the impact of the tool regarding the established improvements related to learning.

Required resources

• I have considered the duration of each of the tests to be performed

• I have considered the resources (personnel, economic) required by each of the evaluation tests to be performed.

• I have selected standardized or previously validated instruments to measure the results of each of the evaluation tests to be performed.

• I have considered the use of self-reports in evaluations.

• I have considered the analysis of the tool log files in the evaluations.

• I have considered the data sources required to perform each of the evaluation tests to be performed.

Participants

• I have considered all the stakeholders in the evaluation tests that were defined:

• Academic Staff • Students • Managers • Researchers • Technicians

Importance of the pilot test

• I have verified that the tests or evaluations defined are aligned with the objectives for which the tool is to be implemented.

• I have clearly defined the objective and expected results of each of the evaluations to be performed.

Ethical consideration

• I have taken into account the ethical aspects to consider for all the evaluation tests to be performed.

A3. APPENDIX ETHICAL DIMENSION

A3.1. Documents and frameworks on ethical and privacy considerations in the design and implementation of learning analytics

Documents and frameworks on ethical and privacy considerations can serve as a reference to inform the learning analytics project stakeholders about the aspects to be considered in relation to data processing.

Reference 1. Code of learning analytics practices

Objective: To establish the responsibilities of educational institutions to ensure that the design and implementation of learning analytics solutions are performed responsibly, adequately and effectively, addressing the legal, ethical and logistic problems that may arise.

Adopted reference: JISC (2015). Code of practice for learning analytics, https://www.jisc.ac.uk/guides/code-of-practice-for-learning-analytics

Abstract

This code of practice for the learning analytics aims to define the responsibilities of educational institutions to ensure that the adoption of learning analytics occurs in a responsible, appropriate and effective manner, addressing the main legal, ethical and logistic problems. In the United Kingdom, educational institutions have information management practices and procedures, as well as extensive experience in the handling of confidential and personal data in accordance with the Data Protection Act of 1998. These codes adapt and transfer this experience to regulate data processing for learning analytics in other institutions.

Ethical and privacy considerations

- **Responsibility:** Institutions must decide who is responsible for the legal, ethical and effective use of learning analytics in relation to data collection, anonymization of data, analysis, data-based interventions, storage and administration of data.
- **Transparency and consent:** Students should be asked for their informed consent for the interventions based on educational data. This consent must be clear and significant enough to ensure voluntariness and contemplate voluntary exclusion without penalty. In addition, the collection and use of data may require additional measures, such as assessments of impact on privacy and obtaining additional consent.
- **Privacy**: Institutions must ensure that student data are protected when they hire third parties to store data or perform learning analytics on them. Access to educational data and its analysis should be restricted to those individuals who have the necessary legitimacy to

see them according to institutional criteria. The use of "confidential data" requires additional guarantees.

- **Validity:** Institutions must control the quality, robustness and validity of their data and analytical processes by ensuring and maximizing their understanding and minimizing their inaccuracy. When facing incomplete datasets, institutions should select an optimal range of data sources and avoid false correlations.
- **Access:** Students should be able to access all the analysis of their data in significant and accessible formats, as well as see the metrics and attached labels.
- **Facilitate positive interventions:** Institutions should specify under what circumstances interventions based on learning analytics should be implemented with the focus of supporting students. Institutions must clearly specify the type and nature of these interventions.
- **Minimize adverse impacts:** Institutions should take measures to ensure that standards, categorization or any labeling of students do not bias the perceptions or behaviors of managers and professors. No intervention based on learning analytics should reinforce discriminatory attitudes or increase social power differentials.
- **Administration:** The data for the learning analysis will comply with the existing institutional data policies or other regulations at the regional and national levels. At the request of the students, any personal data used for or generated from a strategy based on learning analytics must be destroyed or anonymized, with the exception of certain, clearly specified data fields required for educational purposes such as qualifications.

Reference 2. Privacy and learning analytics: they are a delicate topic-DELICATE

Objetive: This document analyzes different points of view related to the use of learning analytics to benefit students, and the uncertainty that exists when using educational data. In addition, the proposals made by the learning analytics community to address the fears and conflicts of using educational data to promote student success are addressed. Adopted reference: Draschler, H. & Greller, W. (2016, Abril). Privacy and Learning Analytics – it's a DELICATE issue. Paper presented at Learning Analytics Knowledge, Edinburgh, United Kingdom. https://dspace.ou.nl/bitstream/1820/6381/1/Privacy%20a%20DELICATE%20issue%20%28Drachsler%20%26%20Greller%29%20-%20submitted.pdf

Abstract

This document consists of an eight-point checklist called DELICATE, which can be applied by researchers and managers responsible for institutional policies. Its objective is to facilitate the design and reliable implementation of tools based on learning analytics. The authors distinguish between ethics and privacy, with ethics being a moral code of norms and conventions at a social level that impact on a personal level, while privacy is an intrinsic part of a person's identity and integrity. Based on these definitions, the authors raise questions and considerations that the institutions must be able to answer in order to be in line with the European legislation on personal data, and with the principles of fair information practices proposed by the Organization for Economic Cooperation and Development (OECD). Both frameworks are widely accepted, reflecting the laws of many US states, other nations and other international organizations.

Ethical and privacy questions and considerations

- Determination:
  - What is the reason for applying learning analytics?
  - What is the added value of learning analytics?
  - What are the rights of its users?
- Explanation:
  - What are the objectives and limitations?
  - What data will be collected and for what purpose?
  - How long will the data be stored?
  - Who has access to the data?
- Legitimacy:
  - Why is there access to certain data?
  - What sources of information are available?
  - Why would someone be authorised to collect additional information?
- Involvement:
  - Involve all key players and users
  - Be open to concern about privacy
  - Inform these actors and users about the information collected
- Consent:
  - Make a contract with data providers
  - Provide data providers with informed consent prior to collecting their information
  - Define a consent with clear and understandable information
  - Provide the opportunity to exclude oneself from the collection without consequences
- Anonymity:
  - Ensure that information at the individual level is not obtainable
  - Anonymize information as much as possible
  - Add data for modeling
- Technology:
  - Develop procedures to guarantee privacy
  - Regularly monitor who has access to the data
  - Update privacy regulations if the analytics changes
  - Ensure that the storage of the data complies with international standards
- External:
  - Ensure that external analytics providers comply with the regulations that apply
  - Sign a contract that defines who is responsible for data security
  - The data must be used only for the proposed functions and not others

Reference 3. Ethical and privacy principles for learning analytics

Objective: To identify a set of principles to support the design and research of learning experiences where important ethical and privacy issues are considered. Adopted reference: Pardo, A. & Siemens, G. (2014). Ethical and privacy principles for learning analytics. *British Journal of Educational Technology, 45* (3), 438-450. https://doi.org/10.1111/bjet.12152

Abstract

This document promotes the creation of confidence in the adoption of learning analytics to solve problems such as: proximity with the rest of the users, and/or the user knowing exactly which of their data is being used for learning analytics. Based on a series of frameworks, this document defines privacy as the regulation of how to observe personal digital information and how to distribute it to other observers, and ethics such as the systematization of correct and incorrect behavior in virtual spaces according to all stakeholders. From these definitions, we present a description of the ethical and privacy issues when they manifest themselves in the specific context of the learning analytics investigation.

Ethical and privacy considerations

- **Transparency.** This principle goes beyond the use of student consent to collect data. In general terms, the three stakeholder groups - students, professors and managers - should have access to the description of how the analytics process is performed and should be informed about the type of information that is collected, including the form in which it is collected, stored and processed.
- **Students' control over the data**. This principle is related to the principle of transparency in the sense that, in order for students to have control over the data that is collected, they need to know what is collected, when, how and how the data are manipulated. The main aspect derived from this principle is the right of users (in this case, students or professors) to access and correct the data obtained about them.
- **Access rights.** The data collected must be under a set of clearly defined access rights. Educational institutions should pay special attention to this principle, since the effect of exposing confidential data to the public can have a profound impact on all interested parties. Due to the variety of tools and users that can access the data, a detailed access policy is recommended.
- **Accountability and measurement.** Each aspect must have a person, department or institution identified as responsible for the correct functioning of the components related to learning analytics. The identification of the entities responsible for the specific data and the areas of analysis is accompanied by the principle of evaluation. By evaluation, we also refer to the responsibility of the institution to constantly evaluate, review and refine data collection, security, transparency and accountability.

Reference 4. LEA in Private: A Privacy and Data Protection Framework for a Learning Analytics Toolbox

Objective: To develop a comprehensive privacy and data protection framework based on existing guidelines, approaches and regulations for the LEA's BOX project (or other related projects) Adopted reference: Steiner, C. M., Kickmeier-Rust, M. D. & Albert, D. (2016). LEA in Private: A Privacy and Data Protection Framework for a Learning Analytics Toolbox. *Journal of Learning Analytics, 3* (1), 66-90. https://files.eric.ed.gov/fulltext/EJ1126798.pdfg

Abstract

This document comprises a set of eight principles to derive considerations to guarantee the ethical treatment of personal data in the design and implementation of tools and support services based on learning analytics. The privacy and data protection policy established from this framework of considerations was translated into the tools and analytical learning technologies developed for the LEA's BOX project (www.leas-box.edu). This research and development project is funded by the European Commission for the development of a learning analytics tool, so it had to comply with the current European Union data protection legislation from 1995 that applies to the countries of the European Economic Area. However, they can be adapted and/or adopted for other learning analytics projects.

Ethical and privacy considerations

- **Data privacy.** The collection and use of personal data must be fair, providing adequate protection of privacy. Information about privacy policies and data protection should be available and easily understood. Users who feel that their privacy is in danger can show resistance (Greller & Drachsler, 2012). Users, particularly those who may feel that their privacy is at risk, should be assured that their data is used in an acceptable and consistent manner. In addition, institutions must develop and disseminate policies and guidelines to protect data from abuse.
- **Purpose and ownership of the data.** The purpose and limits of any learning analytics application must be clearly defined and available before the processing of educational data begins. The data controller is a physical or legal person or authority that processes personal data and determines the purpose of the processing. The interested party has the right to receive information about the identity of the data controller (including contact data) and the purposes of processing.
- **Consent:** The institution must apply appropriate techniques to obtain the consent of students as a legal basis to process personal data. The institution must compile the students' consent needs, establishing it as a basic ethical principle and procedure. In addition, the institution must inform users about the collection of their data.
- **Transparency and trust.** The people who provide data (that is, generally the students, but also the professors) should receive a notice about what type of data is collected and recorded. In addition, they should be provided with information on how analytical processing is performed, since transparency also means providing information about data management procedures, the treatment of data after its primary purpose and the dissemination of data outside (or inside) the institution.

- **Access and control.** The institution provides access to the users to the data collected about them, and the opportunity to correct that data if necessary. The principle of access and participation is reflected in the legislation as a right of the interested party.
- **Accountability and measurement.** The institution, the department or the person in charge or responsible for a learning analytics application must ensure its proper functioning. In addition, the process of adopting learning analytics should be evaluated to refine data collection, management and analysis.
- **Data quality.** The data must be representative, relevant, accurate and updated. Information that is not up-to-date cannot be considered reliable as it only reflects the academic situation of a student.
- **Data management and security.** The data must be kept safe and secure at different levels and by different measures according to the legal structures that apply. Accountability, therefore, requires safeguarding data protection; and the data processing must comply with the data protection regulations demonstrably. Institutions must take appropriate measures to protect the data against unauthorized access, loss, destruction or misuse.

A3.2. Informed Consent Form for Institutional Leaders

Informed consent template that can be adapted to interview institutional leaders in the institutional analysis part.

DISCLOSURE FOR THE PARTICIPANT

Research project: *Building Capacity to Use Learning Analytics to Improve Higher Education in Latin America (LALA)*

(1) What is the project about?

The objective of the LALA project is to build capacities for the adoption of learning analytics tools in higher education institutions in Latin America. The learning analytics involves the collection and analysis of educational data, such as grades and class attendance, with the objective of obtaining information on how students approach their studies and implementing services to improve their learning processes. For example, alert systems can be developed to offer support to students who are at risk of failing a course or abandoning their studies. The systems that analyze the hours invested by a student in an online or face-to-face learning environment can also be developed to determine the time spent on a course or module. In this way, the use of educational data in services based on learning analytics provides information to identify any type of problem that may affect the learning process of a student.

Based on this context, these interviews are intended to get to know various opinions about the use of the educational data in different higher education institutions, and expectations about the services that could be developed from these data.

(2) Who is developing this project?

In the context of the Pontificia Universidad Católica de Chile (UC), the professor in charge of the research is *Name in Charge*, and the Coordinator in charge is *Name in Charge*, Deputy Director of Engineering Education, School of Engineering, Pontificia Universidad Católica de Chile. Vicuña Mackenna 4860, Macul, Santiago. Phone: (562) 354-7201. Email: *Add e-mail*. However, researchers and professionals from other European (Catholic University of Louvain in Belgium, University of Edinburgh, and Universidad Carlos III de Madrid) and Latin American institutions (Universidad Austral de Chile, Universidad de Cuenca in Ecuador, ESPOL in Ecuador) are also participating.

(3) Who is financing this project?

This project is funded by the Erasmus+ programme by the European Commission.

(4) What does the study involve?

The study involves the generation of a framework to favor the adoption of learning analytics tools, in addition to the testing of this framework through the piloting of analytics tools developed by European institutions. In the context of the generation of this framework, interviews will be conducted with institutional leaders, professors and students of the UC and other institutions in Latin America.

(5) How long will the study last?

The project lasts three years. Regarding the interviews, each one has a maximum duration of one hour.

(6) Can I retire early from the interview?

Participation in this project and its interviews is voluntary, you have the right not to participate if it is not convenient.

(7) Who will know the results?

The information collected in this interview will be used in an aggregate form to develop a framework that facilitates the definition of institutional policies associated with the use of educational data. To support the information gathered in this interview and facilitate its subsequent analysis, this interview will be recorded, but this recording can be interrupted at any time a participant requests it.

(8) Who is responsible for all records and data?

The Directorate of Engineering Education is the entity responsible for all the data collected through the interviews at the Pontificia Universidad Católica de Chile, with Professor Mar Pérez as its director. This Directorate will ensure that the data is protected and analyzed, safeguarding the privacy of the participants.

(9) Will I benefit from participating in this study?

There are no benefits associated with participation in this study.

(10) Is there any type of risk associated with participation in this study?

There are no risks associated with participation in this study.

(11) Can I tell other people about the study?

The LALA project is public, so you can tell other people about the existence of this project and your participation in this interview.

(12) What should I do if I need more information?

When you have read this information, the person in charge of administering the questionnaire will answer any questions you may have. If you wish to delve further into some aspect of the study, you can contact the project coordinator directly at (02) 2354-7201 or by email at ihillige@ing.puc.cl.

(13) What should I do if I have a complaint or concern?

Anyone with concerns or complaints about the conducting of a research study can contact the Scientific Ethics Committee at Social Sciences, Arts and Humanities of the Pontificia Universidad Católica de Chile, represented by Mr(s). María Elena Gronemeyer, President of the Ethics Committee, by phone (02) 2354-2936 or by email sent to the address eticadeinvestigacion@uc.cl

Do not sign this letter until you have read all the information provided and have asked all the questions you want. You will be given a copy of this document.

INFORMED CONSENT FORM

I, ..., give my consent to participate in an interview that is part of the collection of information for a deliverable of the European LALA project, coordinated by the Directorate of Education in Engineering of the Pontificia Universidad Católica de Chile

By giving my consent, I acknowledge that:

1. I have read the Disclosure for the Participant and have been offered the opportunity to review all information about my participation in the project.
2. I understand that my participation in this instance is completely voluntary - I am not under any pressure to participate or give my consent.
3. I understand that my participation is strictly confidential and that no information revealing my identity will be used in any way.
4. I understand that my participation does not imply any type of risk.
5. I understand that my participation does not involve any type of compensation.
6. All the procedures and the estimated time required to participate in the instances of this project have been explained to me, and any questions about the project have been answered to my satisfaction.
7. I understand that I can withdraw from this project at any time, without affecting my relationship with the researcher now or in the future.
8. I understand that if I do not want to continue answering questions in an interview or allowing observations of my classes, I can withdraw at any time. Any information that may have been given to the researcher up to that moment will be destroyed.

Signature: ....

Date:

Name Principal Investigator	*Name* President Scientific Ethics Committee in Social Sciences, Arts and Humanities
Phone number email:	*Phone number* *email*

A3.3. Informed consent form for professors

Informed consent template that can be adapted to interview institutional professors in the institutional analysis part.

DISCLOSURE FOR THE PARTICIPANT

Research project: *Building Capacity to Use Learning Analytics to Improve Higher Education in Latin America (LALA)*

(1) What is the project about?

The objective of the LALA project is to build capacities for the adoption of learning analytics tools in higher education institutions in Latin America. The learning analytics involves the collection and analysis of educational data, such as grades and class attendance, with the objective of obtaining information on how students approach their studies and implementing services to improve their learning processes. For example, warning systems can be developed to offer support to students who are at risk of failing a course or abandoning their studies. The systems that analyze the hours invested by a student in an online or face-to-face learning environment can also be developed to determine the time spent on a course or module. In this way, the use of educational data in services based on learning analytics provides information to identify any type of problem that may affect the learning process of a student.

Based on this context, these interviews are intended to get to know various opinions about the use of the educational data in different higher education institutions, and expectations about the services that could be developed from these data.

(2) Who is developing this project?

In the context of the Pontificia Universidad Católica de Chile (UC), the professor in charge of the research is *Name in charge*, and the Coordinator in charge is *Name in charge*, Deputy Director of Engineering Education, School of Engineering, Pontificia Universidad Católica de Chile. Vicuña Mackenna 4860, Macul, Santiago. Phone: (562) 354-7201. Email: *mail to be included.* However, researchers and professionals from other European (Catholic University of Louvain in Belgium, University of Edinburgh, and Universidad Carlos III de Madrid) and Latin American institutions (Universidad Austral de Chile, Universidad de Cuenca in Ecuador, ESPOL in Ecuador) are also participating.

(3) Who is financing this project?

This project is funded by the Erasmus+ programme by the European Commission.

(4) What does the study involve?

The study involves the generation of a framework to favor the adoption of learning analytics tools, in addition to the testing of this framework through the piloting of analytics tools developed by European institutions. In the context of the generation of this framework, interviews will be conducted with institutional leaders, professors and students of the UC and other institutions in Latin America.

(5) How long will the study last?

The project lasts three years. Regarding the focus group it has a maximum duration of one hour.

(6) Can I retire early from the interview?

Participation in this project and its interviews is voluntary, you have the right not to participate if it is not convenient.

(7) Who will know the results?

The information collected in this interview will be used in an aggregate form to develop a framework that facilitates the definition of institutional policies associated with the use of educational data. To support the information gathered in this interview and facilitate its subsequent analysis, this interview will be recorded, but this recording can be interrupted at any time a participant requests it.

(8) Who is responsible for all records and data?

The Directorate of Engineering Education is the entity responsible for all the data collected through the interviews at the Pontificia Universidad Católica de Chile, with Professor Mar Pérez as its director. This Directorate will ensure that the data is protected and analyzed, safeguarding the privacy of the participants.

(9) Will I benefit from participating in this study?

There are no benefits associated with participation in this study.

(10) Is there any type of risk associated with participation in this study?

There are no risks associated with participation in this study.

(11) Can I tell other people about the study?

The LALA project is public, so you can tell other people about the existence of this project and your participation in this interview.

(12) What should I do if I need more information?

When you have read this information, the person in charge of administering the questionnaire will answer any questions you may have. If you wish to delve further into some aspect of the study, you can contact the project coordinator directly at (02) 2354-7201 or by email at ihillige@ing.puc.cl.

(13) What should I do if I have a complaint or concern?

Anyone with concerns or complaints about the conducting of a research study can contact the Scientific Ethics Committee at Social Sciences, Arts and Humanities of the Pontificia Universidad Católica de Chile, represented by Mr(s). María Elena Gronemeyer, President of the Ethics Committee, by phone (02) 2354-2936 or by email sent to the address eticadeinvestigacion@uc.cl

Do not sign this letter until you have read all the information provided and have asked all the questions you want. You will be given a copy of this document.

INFORMED CONSENT FORM

I, ...……..............., give my consent to participate in an interview that is part of the collection of information for a deliverable of the European LALA project, coordinated by the Directorate of Education in Engineering of the Pontificia Universidad Católica de Chile

By giving my consent, I acknowledge that:

1. I have read the Disclosure for the Participant and have been offered the opportunity to review all information about my participation in the project.
2. I understand that my participation in this instance is completely voluntary - I am not under any pressure to participate or give my consent.
3. I understand that my participation is strictly confidential and that no information revealing my identity will be used in any way.
4. I understand that my participation does not imply any type of risk.
5. I understand that my participation does not involve any type of compensation.
6. All the procedures and the estimated time required to participate in the instances of this project have been explained to me, and any questions about the project have been answered to my satisfaction.
7. I understand that I can withdraw from this project at any time, without affecting my relationship with the researcher now or in the future.
8. I understand that if I do not want to continue participating in the focus group, I can withdraw at any time. Any information that may have been given to the researcher up to that moment will be destroyed.

Signature: ……………………………………………………………………………………

Date:

Mr(s). XXXXX Principal Investigator	Mr(s). XXXX President Scientific Ethics Committee in Social Sciences, Arts and Humanities
Phone email:	Phone XXXX

A3.4. Informed consent form for students

Informed consent template that can be adapted to interview students at the institution in the institutional analysis part.

DISCLOSURE FOR THE PARTICIPANT

Research project: *Building Capacity to Use Learning Analytics to Improve Higher Education in Latin America (LALA)*

(1) What is the project about?

The objective of the LALA project is to build capacities for the adoption of learning analytics tools in higher education institutions in Latin America. The learning analytics involves the collection and analysis of educational data, such as grades and class attendance, with the objective of obtaining information on how students approach their studies and implementing services to improve their learning processes. For example, warning systems can be developed to offer support to students who are at risk of failing a course or abandoning their studies. The systems that analyze the hours invested by a student in an online or face-to-face learning environment can also be developed to determine the time spent on a course or module. In this way, the use of educational data in services based on learning analytics provides information to identify any type of problem that may affect the learning process of a student.

Based on this context, these interviews are intended to get to know various opinions about the use of the educational data in different higher education institutions, and expectations about the services that could be developed from these data.

(2) Who is developing this project?

In the context of the Pontificia Universidad Católica de Chile (UC), the professor in charge of the research is *Name in Charge*, and the Coordinator in charge is *Name in Charge*, Deputy Director of Engineering Education, School of Engineering, Pontificia Universidad Católica de Chile. Vicuña Mackenna 4860, Macul, Santiago. Phone: *Phone number*. Email:*mail*. However, researchers and professionals from other European (Catholic University of Louvain in Belgium, University of Edinburgh, and Universidad Carlos III de Madrid) and Latin American institutions (Universidad Austral de Chile, Universidad de Cuenca in Ecuador, ESPOL in Ecuador) are also participating.

(3) Who is financing this project?

This project is funded by the Erasmus+ programme by the European Commission.

(4) What does the study involve?

The study involves the generation of a framework to favor the adoption of learning analytics tools, in addition to the testing of this framework through the piloting of analytics tools developed by European institutions. In the context of the generation of this framework, interviews will be conducted with institutional leaders, professors and students of the UC and other institutions in Latin America.

(5) How long will the study last?

The project lasts three years. Regarding the focus groups, each one has a maximum duration of one hour.

(6) Can I retire early from the interview?

Participation in this project and its interviews is voluntary, you have the right not to participate if it is not convenient.

(7) Who will know the results?

The information collected in this interview will be used in an aggregate form to develop a framework that facilitates the definition of institutional policies associated with the use of educational data. To support the information gathered in this interview and facilitate its subsequent analysis, this interview will be recorded, but this recording can be interrupted at any time a participant requests it.

(8) Who is responsible for all records and data?

The Directorate of Engineering Education is the entity responsible for all the data collected through the interviews at the Pontificia Universidad Católica de Chile, with Professor Mar Pérez as its director. This Directorate will ensure that the data is protected and analyzed, safeguarding the privacy of the participants.

(9) Will I benefit from participating in this study?

There are no benefits associated with participation in this study.

(10) Is there any type of risk associated with participation in this study?

There are no risks associated with participation in this study.

(11) Can I tell other people about the study?

The LALA project is public, so you can tell other people about the existence of this project and your participation in this interview.

(12) What should I do if I need more information?

When you have read this information, the person in charge of administering the questionnaire will answer any questions you may have. If you wish to delve further into some aspect of the study, you can contact the project coordinator directly at (02) 2354-7201 or by email at ihillige@ing.puc.cl.

(13) What should I do if I have a complaint or concern?

Anyone with concerns or complaints about the conducting of a research study can contact the Scientific Ethics Committee at Social Sciences, Arts and Humanities of the Pontificia Universidad Católica de Chile, represented by Mr(s). María Elena Gronemeyer, President of the Ethics Committee, by phone (02) 2354-2936 or by email sent to the address eticadeinvestigacion@uc.cl

Do not sign this letter until you have read all the information provided and have asked all the questions you want. You will be given a copy of this document.

INFORMED CONSENT FORM

I, ..., give my consent to participate in a focus group that is part of the collection of information for a deliverable of the European LALA project, coordinated by the Directorate of Education in Engineering of the Pontificia Universidad Católica de Chile

By giving my consent, I acknowledge that:

1. I have read the Disclosure for the Participant and have been offered the opportunity to review all information about my participation in the project.
2. I understand that my participation in this instance is completely voluntary - I am not under any pressure to participate or give my consent.
3. I understand that my participation is strictly confidential and that no information revealing my identity will be used in any way.
4. I understand that my participation does not imply any type of risk.
5. I understand that my participation does not involve any type of compensation.
6. All the procedures and the estimated time required to participate in the instances of this project have been explained to me, and any questions about the project have been answered to my satisfaction.
7. I understand that I can withdraw from this project at any time, without affecting my relationship with the researcher now or in the future.
8. I understand that if I do not want to continue participating in the focus group, I can withdraw at any time. Any information that may have been given to the researcher up to that moment will be destroyed.

Signature: ……………………………………………………………………………………

Date:

Name Principal Investigator	*Name* President Scientific Ethics Committee in Social Sciences, Arts and Humanities
Phone number *Mail*	*Phone number* *Mail*

A3.5. Informed consent form for professors for questionnaire

Informed consent template that can be adapted to interview institutional professors in the institutional analysis part.

DISCLOSURE FOR PARTICIPANTS

Research Project: *Building Capacity to Use Learning Analytics to Improve Higher Education in Latin America (LALA)*

Academic staff's expectations about the use of educational data

Different higher education institutions have implemented services to support the learning process of their students from the collection and analysis of different educational data, such as grades, class attendance, or access to electronic resources (i.e. an alert system for students who are at risk of failing a subject).

In this context, the purpose of this survey is to get to know the opinion of a university's academic staff about the collection and analysis of educational data in their institution. Answering the survey takes approximately 10 minutes and your participation is voluntary.

The following statements describe situations that could occur in the future given the progress of research on the use of educational data in higher education institutions. For each of the statements, indicate the degree of agreement or disagreement by marking an option from 1 to 7 on each scale, where 1 indicates disagreement and 7 indicates agreement.

A set of questions represents whether you would like what is described in the statement to happen at your university. Note: If what is described in the statement is something that you consider highly desirable, select the maximum value on the scale (7)).

Another set of questions represents your perception of what could actually happen at your institution (in relation to what is described in the statement). Note: If the description in the statement is something already implemented at your institution or you think it is highly likely to happen, select the maximum value on the scale (7).

The results of the survey will be used to develop policies associated with the collection and analysis of educational data at different Latin American universities through the project *Building Capacity to Use Learning Analytics to Improve Higher Education in Latin America (LALA)* (https://lalaproject.org/), which is financed by the European Commission and has Latin American and European universities participating. Your answers will be anonymous and will only be disclosed at the aggregate level.

☐

Please, check the box to confirm that you have read the previous information.

A3.6. Informed consent form for students for questionnaire

Informed consent template that can be adapted to interview institutional students in the institutional analysis part.

DISCLOSURE FOR PARTICIPANTS

Research Project: *Building Capacity to Use Learning Analytics to Improve Higher Education in Latin America (LALA)*

Students' expectations about the use of educational data

Different higher education institutions have implemented support services for the learning process of their students from the collection and analysis of different educational data, such as grades, class attendance, or access to electronic resources (i.e. an alert system for students who are at risk of failing a course).

In this context, the purpose of this survey is to get to know the students' opinion about the collection and analysis of educational data in their institution. Answering The survey takes approximately 5 minutes and your participation is voluntary.

The following statements describe situations that could occur in the future given the progress of research on the use of educational data in higher education institutions. For each of the statements, indicate the degree of agreement or disagreement by marking an option from 1 to 7 on each scale, where 1 indicates disagreement and 7 indicates agreement.

A set of questions represents whether you would like what is described in the statement to happen at your university. Note: If what is described in the statement is something that you consider highly desirable, select the maximum value on the scale (7).

Another set of questions represents your perception of what could actually happen at your institution (in relation to what is described in the statement). Note: If the description in the statement is something already implemented at your institution or you think it is highly likely to happen, select the maximum value on the scale (7).

The results of the survey will be used to develop policies associated with the collection and analysis of educational data at different Latin American universities through the project *Building Capacity to Use Learning Analytics to Improve Higher Education in Latin America (LALA)* (https://lalaproject.org/), which is financed by the European Commission and has Latin American and European universities participating. Your answers will be anonymous and will only be disclosed at the aggregate level.

☐

Please, check the box to confirm that you have read previous information.

.

A3.7. Contract for data use and sharing

Contract for the use and sharing of data with actors from the same institution or from other institutions.

DATA USE AGREEMENT

In [Place], at [Month] [Day], [Year], the following data use agreement is agreed between [Name Institution who owns the data], represented by [Mr, Miss, Mrs., Dr.] [Name of person] domiciled in [mailing address], and the recipient of [data details], [name of the institution who received the data], represented by [Mr, Miss, Mrs., Dr.] [Name of person], domiciled in [mailing address].

The purpose of this agreement is to share data access in the context of the [Project Name], under the direct supervision of [Principal Investigator].

Both sides, recognizing each other through this agreement, ensure sharing information containing personal data, of which the recipient is responsible for its confidential use for the purposes stated in this document. According to the points made in Articles 4°, 5° and 12° of the Law No. 19.698 for the legislation and protection of personal data, both parties agree the following:

1. The issuer will be responsible for preparing data for submission.

2. The receiver will be responsible for processing and using the data for the purposes defined in this agreement.

3. This agreement will enter into force from the date of signature, and it will last until the agreed completion date.

4. The issuer will maintain at all times the ownership of the data, even with the modifications suffered during its analysis. Therefore, the exclusive property rights will be preserved.

5. The data will be treated only under the agreed purpose and it will not be used for a purpose other than the one specified in this agreement.

6. The receiver will not disclose personal information.

7. The receiver ensures that the staff who is going to access the data is subject to all the provisions of this agreement. This obligation extends to any person or company that through the receiver has access to the data.

8. The receiver will be responsible for data breaches concerning the use of the data for purposes not agreed in this contract, and / or disclosure to persons or entities not specified in this document.

9. The documentation drawn up by the receiver’s use of the data will be available to the issuer to their simple request.

A4. Communal dimension Annex

A4.1. LALA community statute

WORKING STATUTES OF THE LALA COMMUNITY

CHAPTER ONE: GENERAL PROVISIONS.

Article 1 - Purpose

The purpose of this regulation is to regulate the operations of the Community of Learning Analytics, hereinafter LALA Community, as provided in the activity A 1.3 of the Erasmus + LALA project "Building Capacity to Use Learning Analytics to Improve Higher Education in Latin America", funded by the European Commission with reference 586120-EPP-1-2017-1-ES-EPPKA2-CBHE-JP.

Article 2 - Scope

This Regulation establishes the operating bases of the LALA Community, as well as its main bodies. This is without prejudice to the specific agreements that the LALA Community implements as tools for its development and growth.

Article 3 – Guiding principles

The following, among others, are considered guiding principles of the LALA Community's activity:

a. Effective communication

b. Permanent commitment to the activities convened by the Community

c. Transparency

d. Objectivity in decision making

All interpretations made with respect to the guiding principles and the scope of this Regulation should seek flexible, efficient and effective applications, in order to ensure the stability and strengthening of the LALA Community.

Artícle 4 – Establishment of the LALA Community

The Learning Analytics Community for Latin America (hereinafter referred to as "LALA Community"), is an international group with open access formed by Higher Education Institutions and related companies, which aims to ensure the sustainability of the results of the LALA project, funded by the Erasmus+ programme of the European Union.

CHAPTER TWO: OBJECTIVES AND INTEGRATION OF THE LALA COMMUNITY

Article 5 – Objectives and functions

The LALA Community's general objective is to promote long-term sustainable cooperation among their members, creating lasting relationships among its members, which contribute to the replication of the results obtained by the LALA project in other contexts. For this, through the LALA community, research and knowledge exchange will be sought to develop local capacity in Higher Education Institutions (hereinafter HEI) in Latin America to create, adapt, implement and adopt Data Analytics tools to improve the academic processes of decision making.

The LALA Community seeks to provide training on optimized methodological processes for the design and implementation of Data Analytics in HEIs.

The LALA Community seeks to promote the training of professionals, professors and researchers related to the processes of creation and administration of Learning Analytics.

The LALA Community seeks to facilitate among its members the exchange of information, good practices, success stories and experiences in the management of Learning Analytics.

The LALA Community seeks to promote and encourage training programs on capacity building in Learning Analytics that will lead to the transformation, modernization and decision making of Higher Education in Latin America.

The LALA Community seeks to promote and facilitate councelling to Higher Education Institutions in the creation of Learning Analytics.

The LALA Community seeks to encourage the periodic holding of conferences and meetings for the exchange of experiences and research results on issues of capacity building in Learning Analytics.

Article 6 – Community members

Active members of the Community are Higher Education Institutions, Research Centers and Regional Organizations linked to Higher Education, which manifest, through the Membership Letter, their interest in being the part of it, agree with the Community's purposes and declare to know and accept the conditions indicated in this Regulation.

There are 2 (two) levels of institution or organization membership, with different rights and obligations:

> The level 0: Receive related news and important information related to the LALA community. They are welcome to meetings and events organized by the LALA community.
>
> The level 1: Contribute knowledge to the community, perform trainings on how to create, adapt and implement Learning Analytics tools, also contribute materials and tutoring. They are welcome to meetings and events organized by the LALA community.

Article 7 – New members of the Community

The LALA Community has an open subscription policy, so without distinction, organizations, companies or academic entities can be added to the community.

The mechanism for incorporating new members into the LALA Community is the approval of the membership application, made through the Membership Letter published on the web, addressed to the coordinator of the LALA Community sent to the following email address: lalaproject@cti.espol.edu.ec The coordinator of the LALA community is a person different to the coordinator of the LALA project. Please see Article 12 for more details about the coordinator of the

LALA community.

The coordinator of the LALA community will inform the other members of the advisory committee about the request received, either in the monthly on-line meeting or in any of the face to-face meetings held during the year, in order to resolve the acceptance or not of the applicant's incorporation into the LALA Community. Said decision is made using any electronic means available through direct vote and by simple majority.

Article 8 – Membership and registration

The coordinator of the LALA community will perform the registration and control of the applicant in the community, according to the resolution of the advisory committee together with the signed Membership Letter.

The coordinator of the LALA community will inform the corresponding resolution to the institution applying, by means of a response letter.

In case of acceptance, once the applicant receives the letter from the coordinator of the LALA community, the applicant is officially considered a member of the Community, acquiring validity the rights and obligations established in this Regulation. Likewise, the new member is informed that their logo already appears in the corresponding section on the LALA project page.

Article 9 – Membership duration

The membership has an indefinite duration barring the following exceptions:

a. Expressed statement to the contrary by the partner institution, which must state it in writing to the coordinator of the LALA community.

b. Exclusion of the associated institution, by deliberation of the advisory committee, due to:

b.1 Failure to comply with its obligations

b.2 Violation of these Regulations, as well as of other regulations issued by the advisory committee b.3 Confirmation of a Member's conduct that is detrimental to the interests of the Community

CHAPTER THREE: MEMBERS' RIGHTS AND OBLIGATIONS

Artículo 10 - Rights of the members of the Community

a) Appoint a representative to the Community, in writing, by a letter addressed to the coordinator of the LALA Community.

b) Participate, through its representative, in the activities performed within the Community

c) Use the tools and services available on the web portal of the LALA project.

d) Access qualified and systematized information of good practices and success cases in the implementation of Data Analytics

Artículo 11 - Obligations of HEIs members of the Community in Latin America

a) Facilitate, through its representative, the participation of local specialists required in the various activities and projects developed by the LALA Community.

b) Support the articulation of the LALA Community and the HEIs that comprise it, with other actors that make up Networks and Organizations of cooperation in management and investigation of Data Analytics.

c) Comply with the commitments that your institution assumes in the Annual Work Plans.

CHAPTER FOUR: COMMUNITY STRUCTURE

Artículo 12 – Organisational Structure of the LALA Community

To ensure the fulfillment of its mission and objectives, the Community will have a basic structure of organization with the following components:

- Advisory committee comprised of one representative of each one of the founding entities of the LALA Community, i.e. for all regular partners of the LALA project.

- The coordinator of the LALA community appointed by the Advisory committee. It is mandatory that this person must be from Latin America and this person will belong to a Latin American institution, but this person must not belong to a European institution in any case.

Article 13 - Organizational functions and responsibilities, and of the LALA Community coordinator

The Advisory Committee of the LALA Community, will be formed by the representatives of the institutions that have participated in the LALA Project as regular partners, being these: Universidad Carlos III de Madrid (Spain), University of Edinburgh (United Kingdom), Catholic University of Leuven (Belgium), Escuela Politécnica del Litoral (Ecuador), Universidad de Cuenca (Ecuador), Pontificia Universidad Católica de Chile (Chile), Universidad Austral de Chile (Chile).

The members of the Advisory Committee have the function of defining and establishing the LALA Community and these statutes, from the various plenary meetings that have been held within the framework of the LALA project.

The members of the Advisory Committee have the right to belong to it because they are founders of the Community, as well as the right to request the nomination of a substitute or their exclusion from the Committee in writing at any time.

The Advisory Committee will have the power to hold virtual and face to face meetings with its members to modify statutes or make relevant decisions in relation to the strategies and objectives of the Community. For the meetings, the participation and approval of at least 50% of their representatives will be sufficient.

The coordinator of the LALA community will carry out the different Community operational actions based on the objectives established in these founding statutes.

The following are competences of the coordinator of the LALA community:

a. To inform the advisory committee about the requests for incorporation of new entities into the Community and their inclusion in the channels.

b. Manage the Community communications in communication channels.

c. Ensure the promotion of the Community to incorporate more interested parties.

d. Represent the LALA Community in congresses or inclusive networks.

e. Resolve any conflicts that may exist among the members of the Community.

Article 14 - Articulation of the LALA Community with other Networks and Institutions

Other organizations related to the nature and objectives of the LALA Community can become associated as guests. The LALA Community seeks the highest spirit of cooperation and articulation with other networks, associations and national and international organizations.

Article 15 – Logo and corporate identity of the LALA Community

The members of the Community accept that, without the prior and written consent of the coordinator of the LALA community, they will not use the name, symbol, brand, banner or any other abbreviation belonging to the LALA Community in advertisements, publicity, etc. In case of expressly authorizing the use of the same, the owner entity will indicate the protocol to be followed for its possible use.

Article 16 – Personal Data Protection Regime

The personal data collected related to this statutes in relationship with the LALA community will only be data of institutions and persons from Latin America. Moreover, personal data collected related to the LALA community will be treated and managed by the coordinator of the LALA community, who will be a person from Latin America and will belong to a Latin American institution.

Personal data will not be transferred or communicated to third parties not even for preservation, so that the LALA Community or external members should refrain from requesting the list of members. The transfer of data to the Public Administration is excepted when it comes from a legal obligation.

The LALA Community seeks the implementation of the necessary technical and organizational measures that guarantee the security and integrity of personal data and avoid their alteration, loss, treatment or unauthorized access.

Article 17 - Amendments to the Statutes

The Statutes may be amended by the LALA Advisory Committee and public notification to the members of the LALA Community through the communication channels.

Article 18 – Settlement of Disputes

In case of dispute over the implementation of these statutes, the parties will seek to resolve them through direct negotiations, previously requesting the advice of the Advisory Committee

Article 19 – Final provisions

Any case not contemplated in these statutes will be considered by the Advisory Committee, which must propose to the Parties a solution for said case and subsequent proposal of amendments to the statutes as necessary

Article 20 - Statutes' entry into force

The present Statutes will come into force as of April 10th, 2019, based on agreement by the Advisory Committee.

A4.2. Letter of membership in LALA Community

Letter of Interest in joining the LALA Community

Country, date

Dear LALA Community Coordinator,

In representation of the institution [name_of_institution], we express our interest in being part of the LALA Community, as part of the Erasmus + LALA project.

Write a brief description of your institution, organization, company and why do you want to be a part of the LALA Community.

In addition, we are committed to disseminate the activities of the LALA project and to participate in the events they organize in order to help to create a learning analytics community in Latin America.

Choose the member level with which you want to join to the network:

☐ Level 0 ☐ Level 1

(Note: Before choosing the member level, it is important that you have read the rights and obligations in the constitution agreement of the LALA Community).

Sincerely,

Name of person filling in the letter of interest	
Position	
Email	

Name of institution, organization or company	
Area (educational, commercial, NGO, etc.).	
Country	
Web page	

____

Signature and Date

A4.3. Researcher registration in the LALA Community

Questionnaire to register as a researcher in the LALA community

URL: https://es.surveymonkey.com/r/ComunidadLALA

Chapter 3: The Final Version of the Design of Learning Analytics Tools

This chapter of the LALA handbook on the adaptation of learning analytics tools is an evolution of the deliverable of the design of learning analytics tools, as an adaptation of tools developed in the European context to the four Latin American institutions that are regular partners of the project. In this evolution, the lessons learned from the pilots are taken into account. Thus, the adaptation of the learning analytics tools has been refined with the lessons of the experiences and pilots in each of the Latin American partners of the project. The adaptation of two tools is reiterated: a counseling tool composed of visualization panels to support decision-making when deciding which subjects to take; in addition to another tool to automatically support the work of students in online learning contexts, and another tool for early warning of academic dropouts. Thus, a brief summary of the initial adaptations is presented, and the changes made based on the piloting experience.

In the process of design and implementation of the learning analytics tools of the LALA project, two parts are distinguished: the backend architecture and the frontend of the tools. In the backend it is mentioned how a generic base was designed so that any Higher Education Institution (IES) can adapt it to their needs. Then, it is described how each university adapts that generic base. On the other hand, in the frontend, each university mentions how was its process of design and adaptation of a tool for academic counseling and early warning of academic dropout, both proposed in the project. In both aspects (backend and frontend), the description of its new versions is added. Although each university had autonomy with this phase, they all focus on constant interaction with the target group and their connection with the LALA framework. Additionally, other analytical tools are included, adapted by universities. The source code of all the tools developed is available at the following link for the use and adaptation of any institution https://git.cti.espol.edu.ec/LALA-Project/.

Finally, the conclusion highlights the contributions of this deliverable and next steps to follow.

3.1 Backend: Generic architecture for the academic dropout early warning system and counseling tool

3.1.1. Generic LALA base: Design and Architecture

In order for any university that wants to use learning analytics to start from a base that can be easily adaptable to each institutional need, it was decided to create a generic database and a generic architecture, based on the needs of the institutions in Latin America. This generic basis of LALA applies to both the counseling tool and the early prediction of dropout.

Figure 3-1 shows an Entity-Relationship diagram of the generic database. And below Table 1 shows a summary of its main fields.

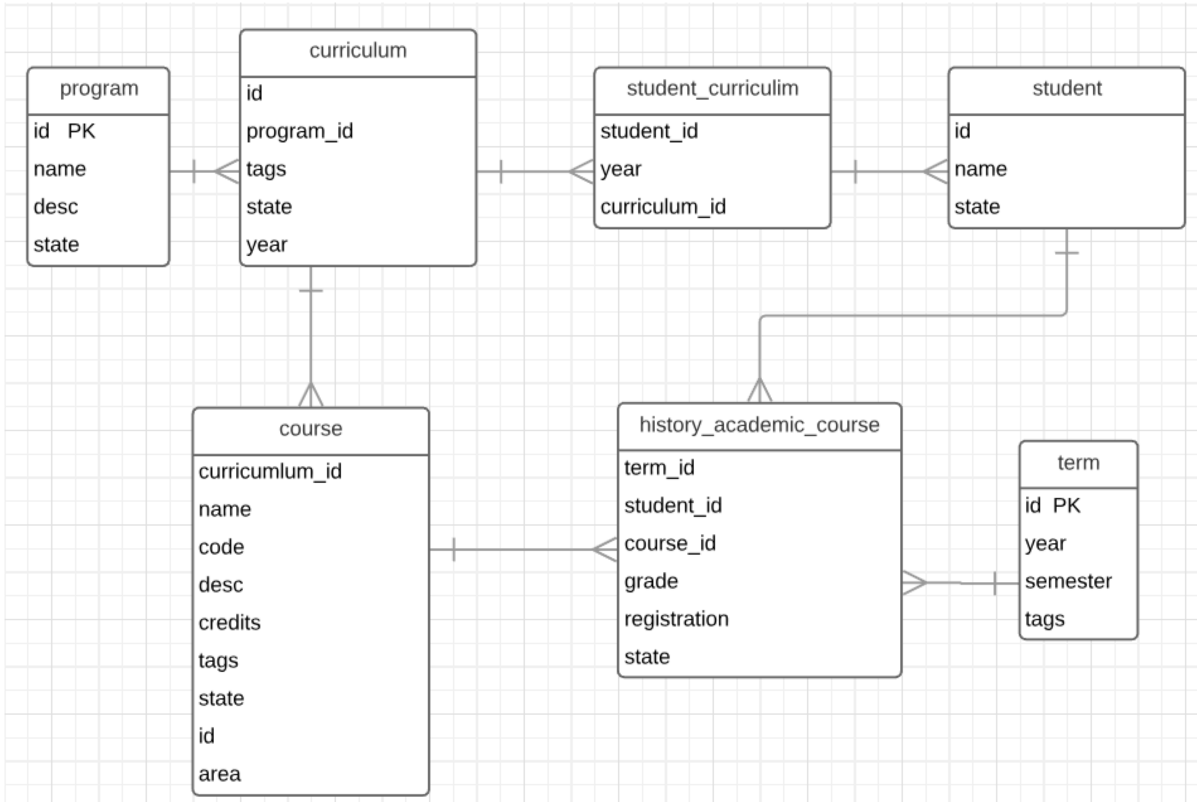


Figure 3-1. Generic Data Base

For the consumption and loading of data from the main application, it was decided to create a REST API with an architecture as shown in figure 3-2, with the aim that in the future not only counseling and early warning systems can consume of academic data, but future applications developed by universities can obtain this data without being linked to a particular application. Thus avoiding connections to the database per application, and centralizing all data access to the developed API. This proposed architecture is the most viable in Latin America, since the majority of IT departments of each institution restrict their access to data to certain systems, this being a limitation when developing independent applications that require the same academic data.

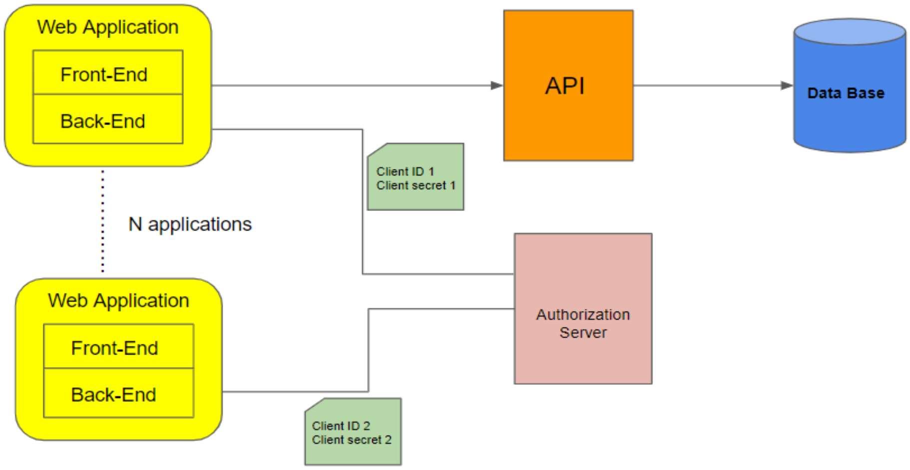


Figure 3-2. General architecture of the system

3.1.2. Adaptations to the generic base

Although a generic base was created, the needs of each university are individual. That is why adaptations are needed. The different adaptations to the generic LALA database that each university made before and after the piloting experience are presented below

3.1.2.1 Adaptations at Escuela Superior Politécnica del Litoral (ESPOL).

Table 3-1 summarizes the additional tables that were added in the version before the pilots, in order to include the necessary information in our visualization panel. Because the API developed was designed in such a way as to be a centralized source of data, it was not necessary to create a different system.

Name	Data stored
Course Available	The courses available to the student during the registration period
Course Counseling	Suggested courses conducted by the counselor during the terms
Wellness	Student Wellness Attendance Records

Table 3-1. Additional tables based on adaptation

3.1.2.1.1 Version based on pilots and experience

Due to the feedback received from teachers and authorities, the need arose to add an additional field to the "Course Available" table called "course level" to complement the decision-making of the subject to be taken. Before, when the counselor chose the subject, only a drop-down list would appear, with this new addition, the list of subjects appears ordered according to the curriculum. Thus, it is easier to identify which subjects the student still needs to take. Regarding architecture, no update was needed based on pilots and experience.

3.1.2.2 Adaptations at Universidad Austral de Chile (UACh)

To meet the specific needs of the context of the Austral University of Chile UACh, the following tables were added. Table 3-2 below shows this summary.

Name	Data stored
Student_statistic_by_term	The student's situation in each semester taken
Student_dropout	The progress of the student in high school and the forecasts of finishing it
Group_course_academic_by_term	The distribution of grades for a given course and semester
Group_course_academic_by_cohort	The distribution of grades for a given course and cohort
Group_course_academic	The historical distribution of grades for a given course

Table 3-2. Additional tables based on adaptation

Additionally, an architecture with three parts was defined as shown in figure 3-3 (A) data services in a backend that generally deliver the data in JSON format; (B) the LA tools that run in the web browser; and (C) a real identifier conversion service -> anonymized

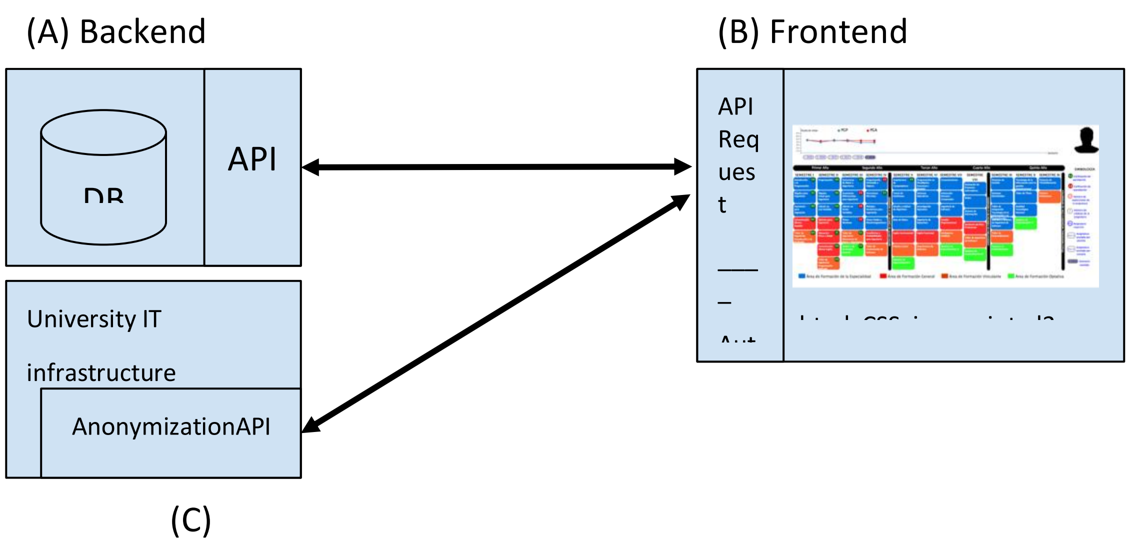


Figure 3-3. System architecture

3.1.2.2 Version based on pilots and experience

Because, in our context, multiple data uploads were carried out during the piloting process and these processes were complex and demanding in terms of the time and effort required to carry them out, a change was made in the data model. A review of the database and subsequent simplification of the relational model were carried out in order to also simplify the data loading process. A set of background information is listed below: i) all tables are updated, and the information does not change until the next data load; ii) several data uploads are carried out in the semester (closing the previous semester, in the course registration period, at the end of the special requests period). Facilitating data loading was prioritized before maintaining a normalized relational model.

In addition, it was decided to divide into 4 different databases according to their different roles in the application, considerably facilitating the migration and backup processes:

- For information on user accounts and roles (Table 3-3).
- ConFiguretion for dashboard conFiguretion variables (Table 3-4).
- Tracking for the registration of dashboard usage logs (Table 3-5).
- data-lala for all information on study programs and academic records (Table 3-6).

Name	**Data stored**
users	Users belonging to the application
user-programs	Table of programs belonging to "Director" type users.
persistence	Application usage data persistence table, allowing the application to “remember” the latest application state in various circumstances after the application is reopened.
conFiguretion	Global application conFiguretion, which allows changes "on the fly".
user_conFiguretion	User-level settings.

Table 3-3. Database “auth-lala”

Name	**Data stored**
course	Generic information for a specific course
course_stats	Statistics of courses in a specific semester-year.
parameter	Parameters related to data loading
program	List of programs
program_structure	Information on courses belonging to programs and curriculums.
student	Students in the system
student_course	Information on students in specific courses and semesters / years.
student_dropout	Probabilistic information generated by AI.
student_program	Student data in relation to their programs.
student_term	Student data by periods / semesters.

Table 3-4. Database “data-lala”

Name	**Data stored**
tracking	Data belonging to tracking.

Table 3-5. Database “tracking”

In relation to architecture, with the aim of maximizing the benefits offered by the technologies used for the implementation of the tools and also, using the “convention over conFiguretion” paradigm, the first version of the tools was refactored.

It was decided to carry out a refactoring that consists of using GraphQL technology for the realization of data schemas and connection between the "backend" and "frontend", improving the ability to evolve it, expressiveness, good "type-safety" and satisfactory development experience (DX), in addition to occupying cutting-edge and established tools in the web development ecosystem.

The following figures (3-4, 3-5) were generated using "GraphQL Voyager" directly from the API schema, which allows visualizing the API in the form of an interactive graph. For more information you can review the interactive graph available at https://trac.lala-uach.online/api/voyager.

It should be noted that the diagrams described in the figures include characteristics that are currently in the testing phase.

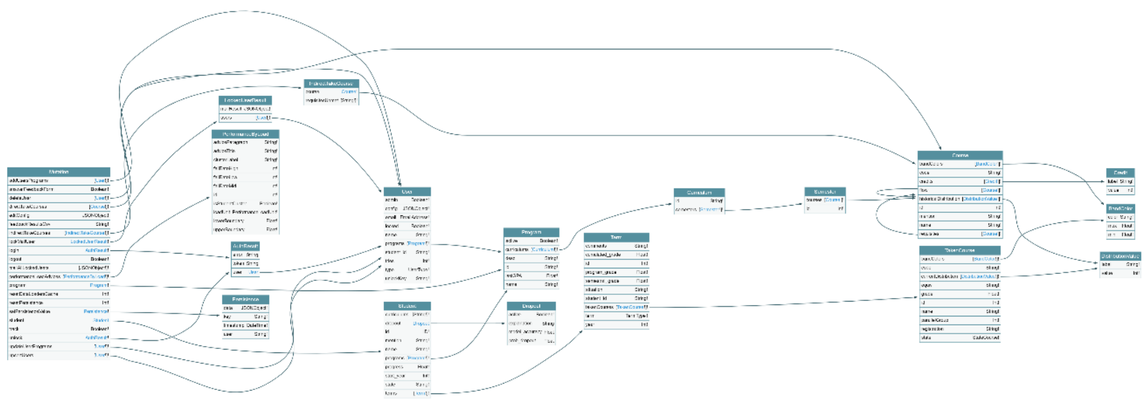


Figure 3-4. API GraphQL “Query” schema.

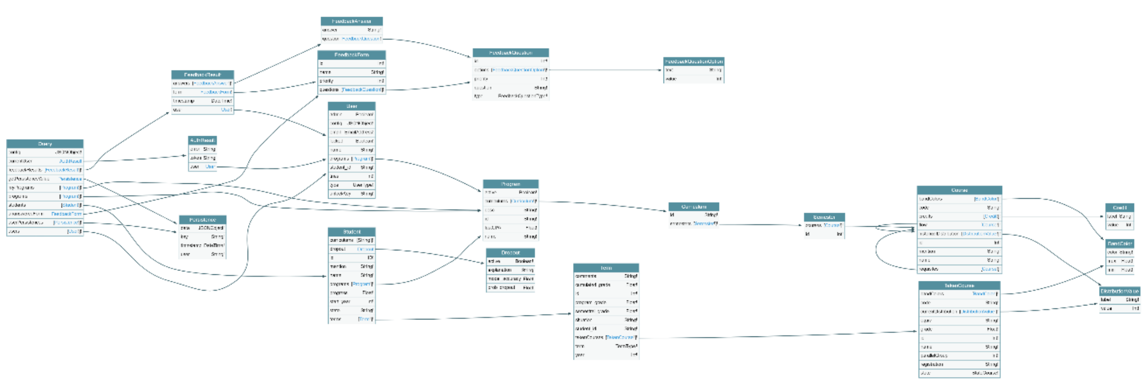


Figure 3-5. API GraphQL “Mutation” schema.

The server side of GraphQL provides services respecting the previously defined data schema and the client side constructs requests that respect the schema and are constructed as a subset of the schema.

For purposes of separation of context on the client side, two groups of requests are considered, requests from the administration panel and requests from the main application, these seek to be expressive and clear in their objectives.

3.1.2.3 Adaptations at Universidad de Cuenca (UCuenca)

In addition to the generic LALA database tables, other tables were added. Table 3-6 summarizes the aggregate.

Name	**Data stored**
program	The careers or programs offered by the university
curriculum	The study plan for the different careers or programs dictated by the university
program_term	Description of the semesters that have been planned for the mesh
course	Indicates the courses associated with the different meshes of the careers or programs taught at the university.
program_course	Indicates the courses planned to be taught in each semester (program_term) of a course or study program (curriculum). Describes the characteristics of a course (course) for a certain course (curriculum) in a semester (program_term). The values in this table do not correspond to a specific student.
term	The term or academic period in which the university taught classes.
student	Students registered by the University
teacher	The professors who taught courses at the university
history_academic_course	The academic record of students at the University.
student_curriculum	Courses the student took or is taking on a course.
counselor	Data is recorded (eg, academic performance) about the different courses (curriculums) that a student has taken. There will be a record for each course the student took.
meeting	College Registered Counselors

Table 3-6. Summary of tables added to generic basis

In relation to the architecture, an architecture with two parts was defined as shown in figure 3-6 (A) data services in a backend that deliver the data in JSON format and (B) the LA tools (visualization panel) that they run in the web browser.

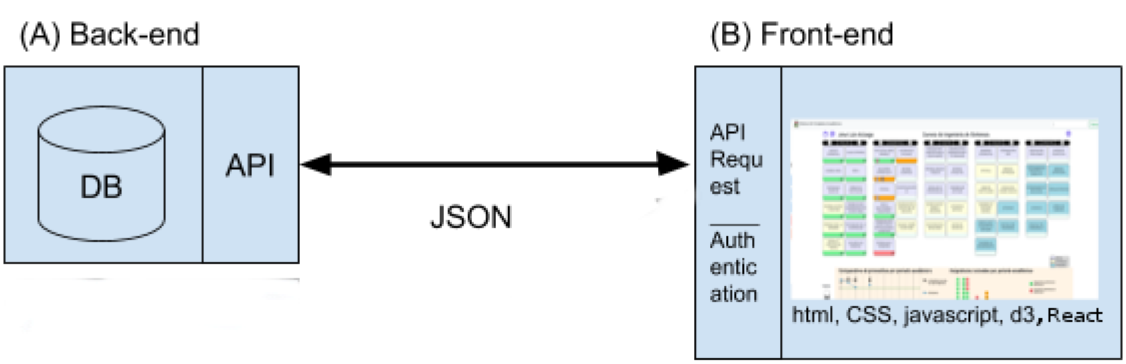


Figure 3-6. Architecture

3.1.2.3 Version based on the pilots and the experience

The data structure and visualizations were modified in order to allow the academic advising dashboard to provide support to faculties whose grading structure differs from the structure used by the faculties participating in the piloting. Changes at the database level allow describing the grade structure in each subject. For example, there are subjects where the final grade obtained by a student is based on a single contribution (exam or final project); while there are other subjects where the grade is obtained as a result of adding the evaluation of different partial contributions (work, exams, projects). Additionally, the faculties assign different names to each of their contributions. For example, some might decide to use the name "Partial 1" for a contribution, while others might use the name "Leverage 1". Regarding the visualizations, these were adapted to present the contributions that make up the student's final grade according to the grade structure of the subject.

Additionally, the data migration processes of the academic system were updated according to the new data structure. Based on the changes, the processes were executed as follows: i) all the tables were updated, and the information did not change until the next data load. ii) Several data uploads were carried out so far this semester (closing the previous semester, at the beginning of the new semester, in the intercycle of the new semester, at the end of the new semester). Table 3-7 summarizes the new tables added.

Name	Data stored
faculty	Existing faculties in the university.
teacher_poll	Teachers' responses about the use and operation of the tool for the exclusive use of teachers.
complexity	Betas (general averages per subject) for calculating the complexity for each of the students' study plan
dropoutporsemestres	Prediction on the retention rate of students in the different careers.
prediction_feedback	Counselors' opinions about the prediction of the student's retention rate in the career.
last_migration_date	Dates of migrations made to the database.
users	All users and roles that they will have for access to counseling tools for the exclusive use of teachers.

Table 3-7. Summary of new tables added

In addition to the tables described above, new tables were created exclusively for data migrations, which serve as a guide for future migrations and updates (See table 3-8).

Name	Data stored
curriculums_ids	Register the new ids for the destination table, which is curriculum, and the original ids for the source table of the university database.
program_term_ids	Register the new ids for the target table, which is program_term, and the original ids for the source table of the university database.

course_ids	Register the new ids for the destination table, which is course, and the original ids for the source table of the university database.
term_ids	Register the new ids for the destination table, which is term, and the original ids for the source table of the university database.
estudiantes	Register all students indicating only academic data, where each record is considered as a student.
calificaciones	It registers the academic history of the students with the necessary fields to make the prediction of the rate of permanence in the career.
calificaciones_ids	Register the ids of the students table and the student table, which will be used to know which student the prediction belongs to.
grade_name	It registers each one of the existing types of qualification for all the faculties (Use I, Use II, Intercycle, Final, etc.).
grade_history_detail	It records the grades obtained by the student in the different subjects that she has taken, or is taking, based on the history and type of grade.

Table 3-8. Summary of tables created for data migration

Due to the changes made in the structure of the database, and according to the pilot process carried out, some web services were modified. In addition, after conducting an in-depth analysis of the changes in the structure of the base and the experience during the pilots, new services were added, which facilitate the extraction and management of data in the front-end, allowing to reduce the loading time of the dashboard.

The web services that make up the backend of the system are described below:

Web Services for Counseling Visualization Tool

<u>Web POST Services</u>

- **Login:** This service checks the credentials entered by the user for the login and delivers the information pertaining to it, including the faculty to which it belongs.
- **changePassword:** This service updates the user's password and delivers a success or error message.
- **addCounselingLog:** This service adds the actions carried out by the user to a log file and delivers a success or error message.
- **saveFeedback:** This service adds a new record with the user's response to the prediction_feedback table and delivers a success or error message.

<u>GET Web Services</u>

- **studentCurriculums:** This service delivers all the curricula or courses that the student has taken or is taking, including additional academic information, such as the number of courses, the general average, number of hours, among others, of each of the courses, as well as well as information on the careers to which each of the curriculums belongs.

- **otherStudentCurriculums:** This service delivers all the resumes or meshes that do not belong to the career or careers that the student is studying, including information on the career to which each of the curriculums belongs.
- **studentInformation:** This service provides general academic information about the student.
- **Dropout:** This service provides information about the student's dropout probability in the selected career.
- **sessionHistory:** This service provides information about the student's session history
- coursesOfCurriculum: This service delivers all courses or subjects, as well as levels or cycles of a curriculum.
- **historyAcademics:** This service provides all the academic history of the student, including courses that have and have not passed.
- **gradesPartners:** This service delivers the percentages according to the grades of all students who are classmates of the analyzed student, including the student.
- **videoHelp:** This service provides a streaming help video.
- **lastTopic:** This service delivers the last topics under which the subject was offered, it only applies to OPTATIVE subjects.

Web services for the teacher visualization tool

POST web services

- **verifyAccess:** This service delivers a message: ATHORIZED or UNAUTHORIZED in case of having or not having access to the tool.
- **savePoll:** This service saves a new record with the teacher's response in the teacher_poll table and delivers a success or error message depending on the case.
- **saveLog:** This service adds the actions carried out by the user to a log file and delivers a success or error message.

GET web services

- **getDocente:** This service delivers the teacher's information.
- **getPeriodo:** This service delivers all the periods in which the teacher has taught.
- **getStudentsAverage:** This service delivers the academic information of the students who have studied with the teacher in a given period.
- **getStudentCurrentCourses:** This service provides the number of courses the student is currently taking.

Web services shared by counseling and teacher tools:

GET Web Services

- **lastMigrationDate:** This service delivers the date of the last migration.

3.2. Frontend: Adaptation of the counseling tool

This section describes the adaptation of the Counseling Tool, focusing on the functional and frontend part. Unlike the backend, the frontend does not have a single generic model due to the different needs that each university has. However, in relation to visualization models, the work carried out by the University of Leuven has been taken as an example due to the systematized work they have carried out in the development of counseling systems (Charleer et al., 2018; Millecamp et al., 2018) and the previous experience of European projects such as ABLE and STELA, adapting the tools of the University of Leuven. Next, it is described how each university adapted the Counseling Tool, using the "LALA Framework" as well as the display screens and functionalities in each one of the cases. In the case of ESPOL, UACH and U. Cuenca, the counseling tool is oriented to the decision in full degrees having general information about the courses, while in the case of PUC the counseling tool is oriented to the decision in specific courses, having detailed specific information of courses.

3.2.1 ESPOL

The tool design process that was followed was an adaptation of processes that combined Design Thinking, agile methodologies and human-computer interaction. After several iterations with low fidelity prototypes, meetings with personnel in charge of the Advisory System, developers and designers, the final beta version is presented below in figure 3-7. It consists of 3 windows: Statistics, Academic History and Available Subjects

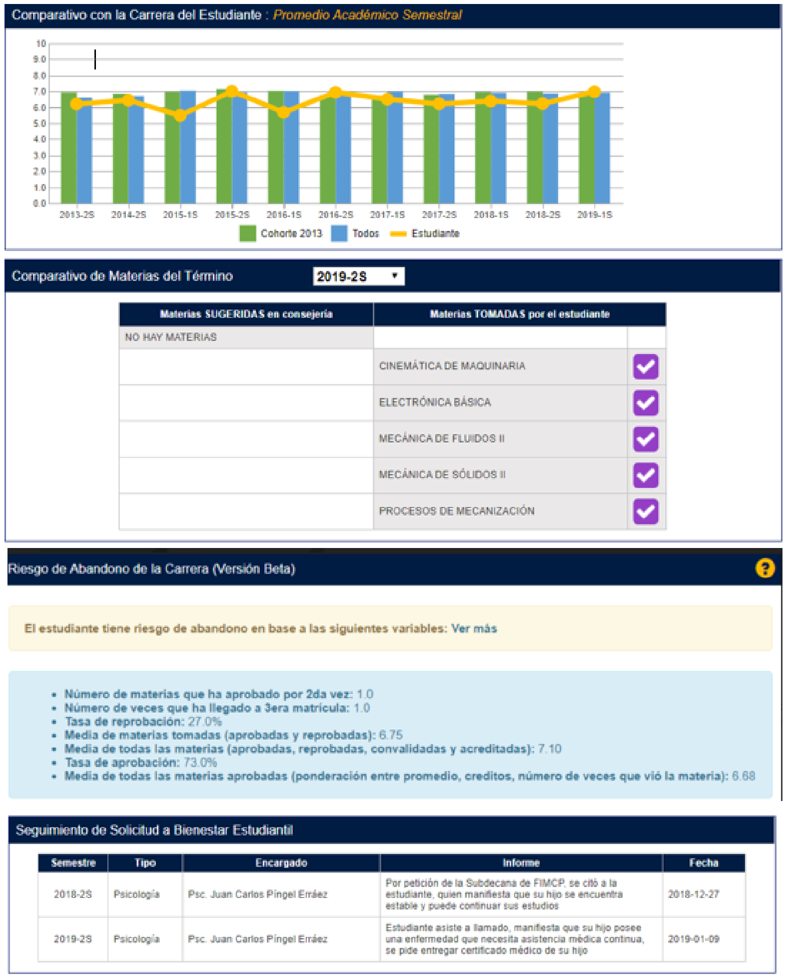


Figure 3-7. Statistics windows

In this window (Figure 3-7), you can see a comparison of the student's average with his peers from the same cohort and all the students who have studied the student's career. Additionally, you can see a comparison of subjects where you can contrast the subjects suggested by the counselor versus the subjects that the student decided to take and how it was performed. In addition, there is the option to select the history of the comparative of subjects in the different semesters. The last visualization is a table where the counselor can review the follow-up of any case that he has reported to the Student Welfare Department.

In this window (Figure 3-8) you can see the entire history of the student. Additionally, you can now enter each subject and review the student's average in relation to his classmates and in relation to all the parallels that took the subject in that semester.in relation to all the parallels that took the subject in that semester.

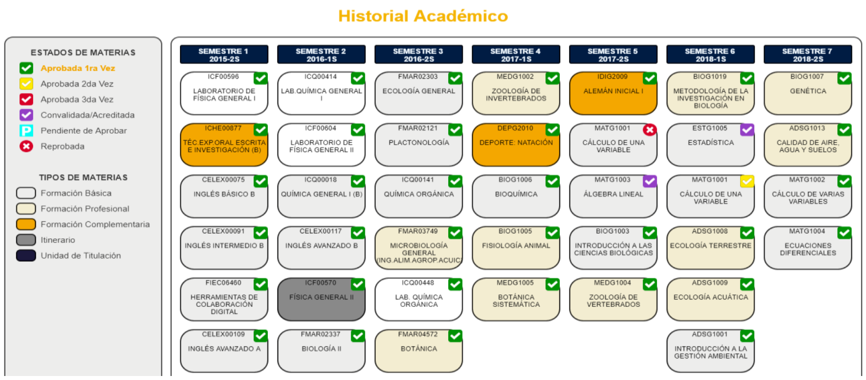


Figure 3-8. Academic History

Finally, in this window you can do simulations by being able to choose the subjects that would be taken in the new semester. Additionally, the weekly hourly load that it would represent is displayed (Figure 3-9).

Figure 3-9. Available subjects window

3.2.1.1 Version based on pilots and experience

The piloting phase made it possible to collect information not only from the teachers who used the system but also from the authorities, as well as from the analytics obtained by the actions of the users in the system. As a result, the following changes occurred:

Split the Statistics window and move to other parts

To achieve greater impact, the modules were moved to the various windows of the current system.

The career comparison module was moved to the main page (Figure 3-10**).**

Figure 3-10. Career comparison moduled moved

The subject comparison module, was moved to the Counseling history page (Figure 3-11)

Figure 3-11. Subject comparison moduled moved

The Student Welfare monitoring module was moved to the main page (figure 3-12)

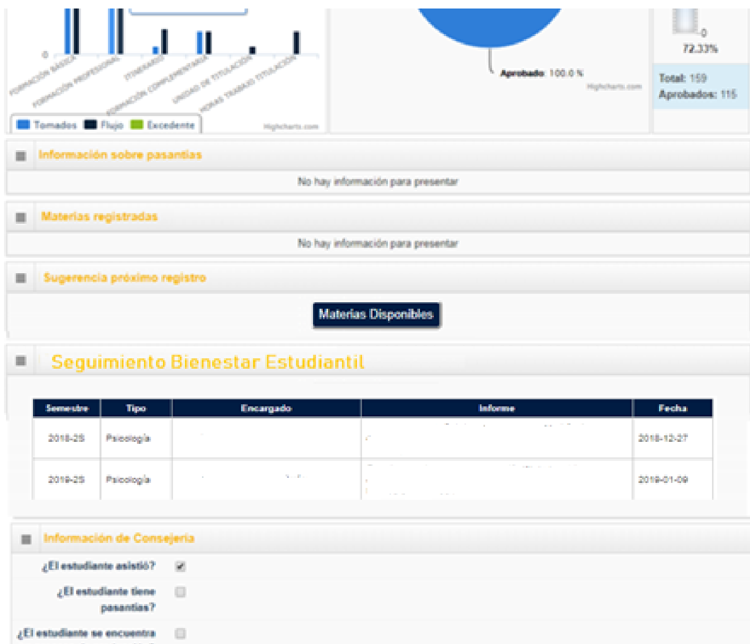


Figure 3-12. Student Welfare monitoring module moved

Available subjects Window

The information of the subjects by level was added. In this way, the teacher can identify which subjects from the academic grid, they must still take (Figure 3-13).

Figure 3-13. Available subjects grouped by level

* Note: No changes were made to the "Academic History" window

3.2.2 UACh

For the requirements survey and design phase, a guiding protocol was defined on how the meetings with the different career directors of the faculty should be carried out to obtain the necessary requirements to build the proposed application. A total of five meetings were held to collect requirements with the directors of the careers of Civil Engineering in Computer Science, Civil Engineering in Civil Works, Mechanical Civil Engineering and finally Electronic Civil Engineering. In addition, a final validation meeting of the prototype was held, which met all the requirements raised in the previous sessions. Finally, the requirements and design decisions raised with the end users were evaluated by the LALA team of the UACh and modifications were made by virtue of incorporating best practices of usability, look & feel and viability regarding the available data and the security policies of the Information technology department of the Institution.

The system is described below:

Application login page, only for users previously registered by the administrator and complying with the security policies of the UACh (Figure 3-14)

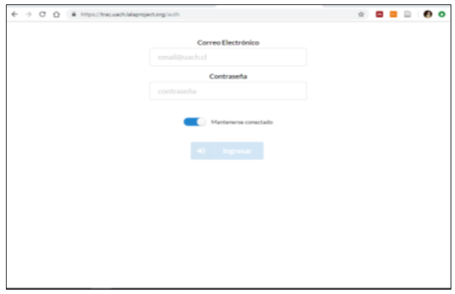


Figure 3-14. Login page

Application header (logout, help): Shows the name of the program and allows searching for the student's RUT or accessing the help (Figure 3-15):

- Displays the ID (RUT) of the student (the real id that the user enters) in an editable text field
- The "Load" button reloads the display panel for the entered RUT
- The date of the last data update is displayed on the right.
- The help button (?) On the right displays a "balloon" with the legend of the display panel.

Figure 3-15. Application header

Study Plan: main area of the application that shows the structure of a study plan in a matrix type layout (Figure 3-16). Each column represents a semester of the study plan. In each semester, the courses are listed down. The semesters are organized in "cycles" that are defined in the study plan. For example, the first cycle "baccalaureate" comprises the first 4 semesters of study. The name of each cycle is shown on the black background separators. The academic information of the student "in counseling" is overlaid on the visualization of the study plan. In this way, the user can view the student's academic progress status. The prototype implements this with colored circles that show the student's final grade in each course. When selecting a subject (click), its block is displayed showing academic information and the rest of the subjects of the study plan are dimmed.

Figure 3-16. Study Plan

Course: Academic information is displayed as a colored bar next to it (Figure 3-17). Next to it improves the "panning" of all the information, where the subject columns have meaning and not the rows. The rating must also be in number, for which it has been widened (with a circle of the same background color) in the position where the rating is located. Background color is one of 4 that represent different ranges of the grade range. If the course has been previously taken, dropped, or failed, a smaller diameter circle appears aligned with the grade circle. The color of the new circle represents the grade obtained using the same scale. Circles corresponding to canceled subjects are colored gray.

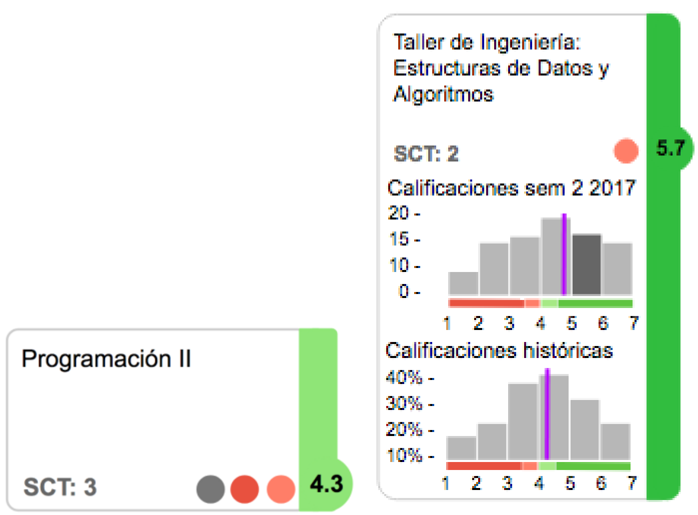


Figure 3-17. Course

Semester average graph: the graph shows the weighted and accumulated semester average of the student in the semesters they have attended (Figure 3-18).

Note that the x-axis does NOT coincide with the columns of the study plan. This is for the purpose of distinguishing the semesters the student has taken from the "ideal" semesters of the study plan. We emphasize this distinction, because it is very rare for a student's N-th semester to coincide with the N-th semester of the program. This is due to the fact that students fall behind in failing subjects.

PSP and stands for Weighted Semiannual Average.

PGA stands for Cumulative General Average. These averages over time allow us to see positive or negative trends and the academic history of the student.

The x-axis labels are also buttons that change the view from the bad one. By pressing a specific semester on the x-axis, the student's academic information from "that moment" is displayed, highlighting the subjects the student was taking in that semester and attenuating the rest of the subjects in the study plan. Figure 3-18 shows this.

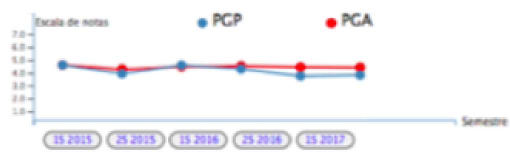


Figure 3-18. Semester average

3.2.2.1 Version based on pilots and experience

During the execution of the pilots, meetings were held with the users where proposals to improve the tools were collected. Although the original design of the tool is quite similar to the first version, improvements have been made. These include minor corrections and some additional functionalities that are detailed below:

- Display of courses currently “taken” with a blue band and label “Reg” (registered). This can be seen in Figure 3-19.
- Semiannual follow-up incorporates PGA of the career (average program cummulated GPA) and marks semester with eliminations and reincorporations. This can be seen in figure 3-20.
- Deployment of required courses and 'post' requirements when selecting a course. This is shown in Figure 3-21.
- An administration panel is incorporated that allows managing user accounts and deployment conFiguretions. This is shown in Figure 3-22.

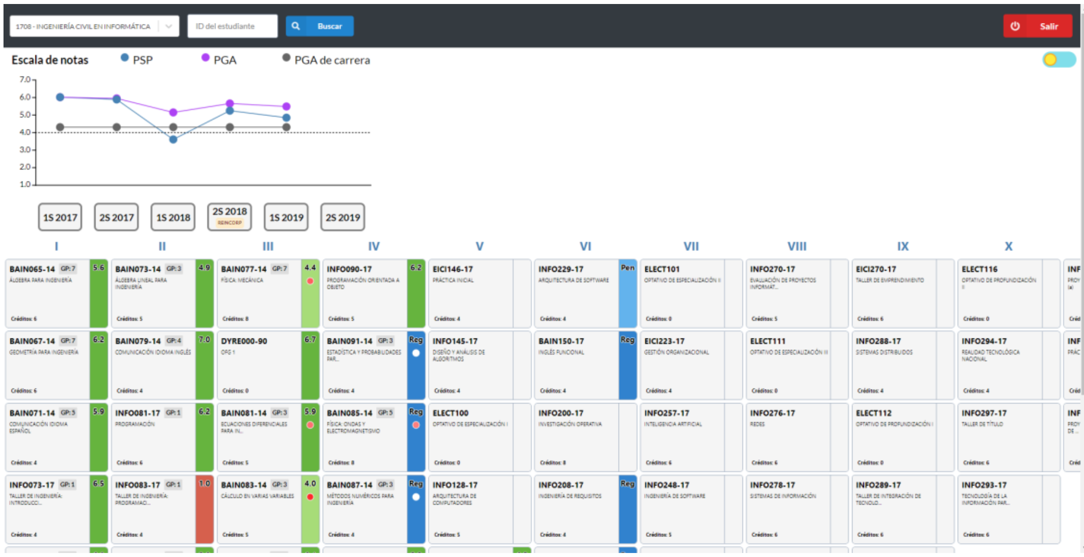


Figure 3-19. Main dashboard director

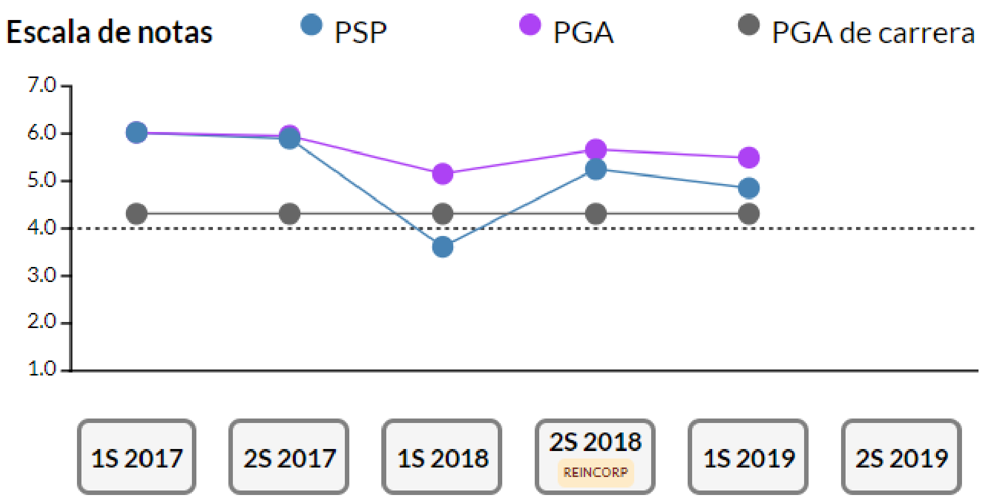


Figure 3-20. Semiannual PSP, PGA, PGA Career follow-up and identification of reinstatements or comments.

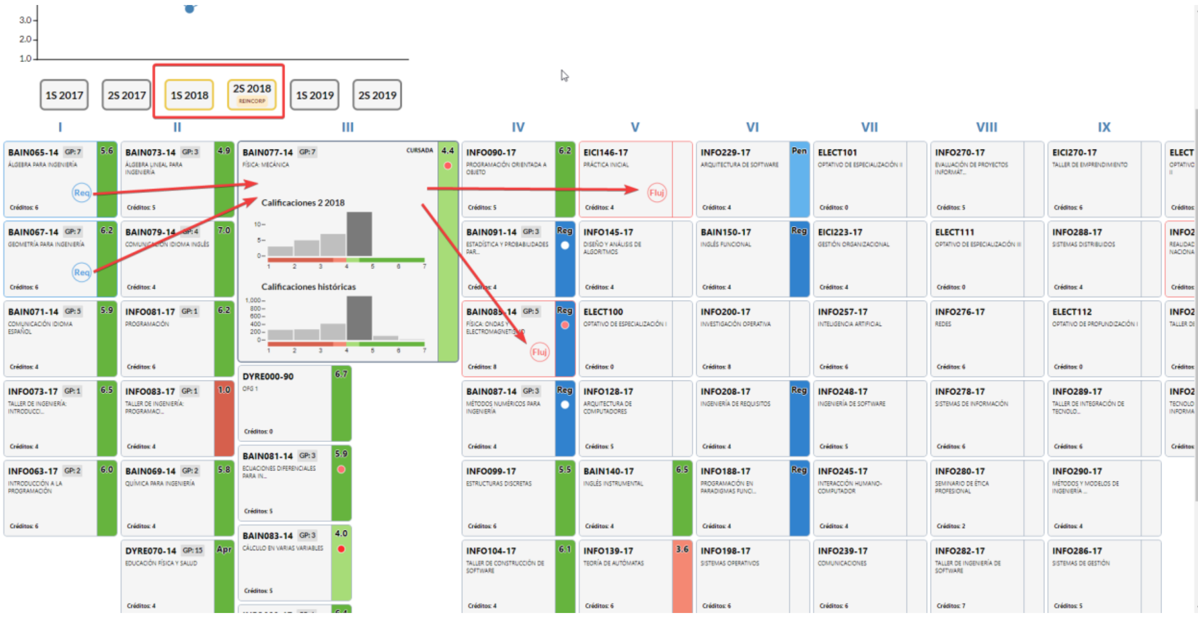


Figure 3-21. Specific course expansion for more details, including pre- and post-requirements.

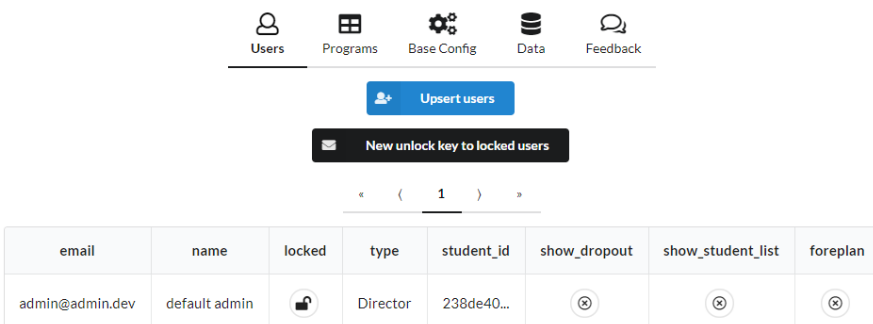


Figure 3-22. Administation dashboard, users tab

3.2.3 U Cuenca

In the context of U Cuenca in which there is no student counseling process and there are no computer tools that support it, the strategy for obtaining requirements was based on taking as a reference the experience of other partners of the LALA Project. The use of these artifacts and the experience of our partners allowed: i) To have a common understanding of what learning analytics tools are; helping to convey to stakeholders' concepts of dashboards in the academic context, preventing them from having their own interpretation of what a dashboard is (e.g., a report that lists pre-filtered information) ii) Establishing a common vocabulary. iii) Evidence that each higher education institution has its own academic focus and requirements, and iii) Obtain information and interaction requirements on learning analytics tools. As a result, version 1.0 of the system is displayed. The general view of the display panel is shown in Figure 3-23 It should be noted that the name used in the figures is fictitious.

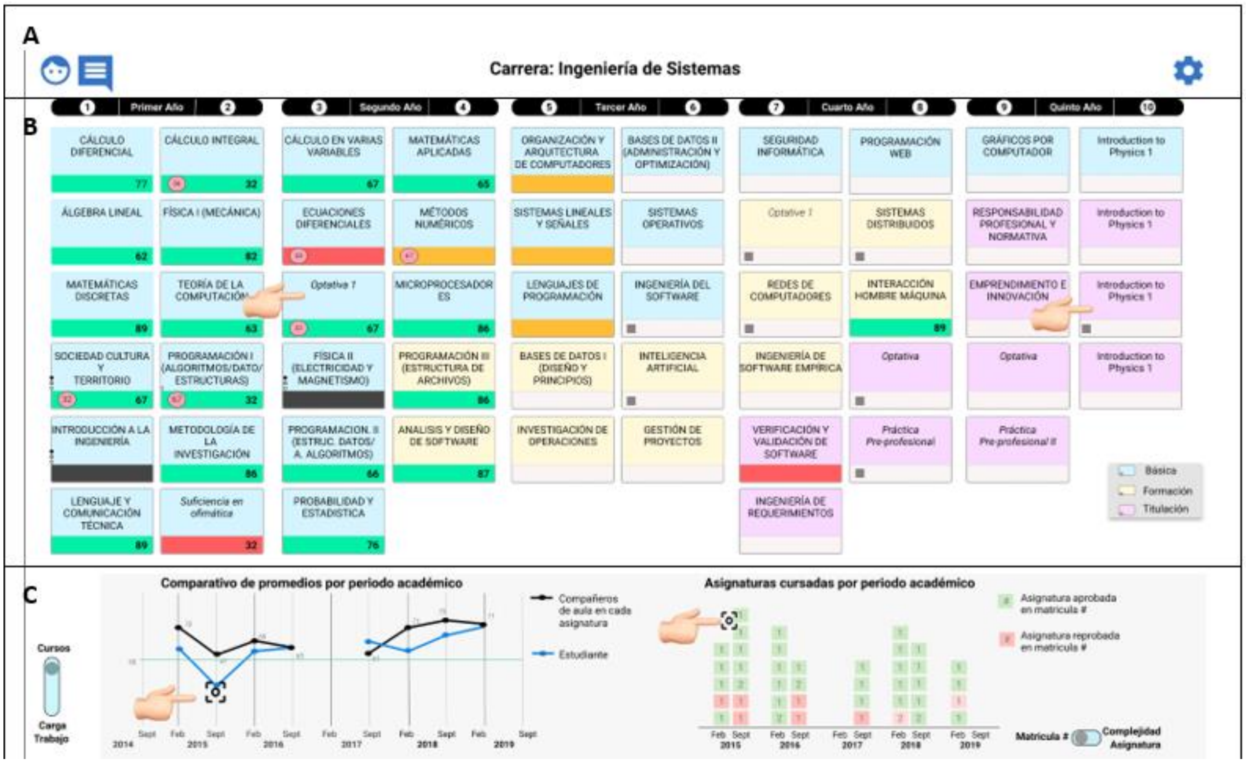


Figure 3-23. General Dashboard

The application has three sections or contexts in which it will be possible to appreciate: (A) the information context of the student, (B) the context of the study plan, and (C) the context that refers to the student's performance.

As can be seen in Figure 3-23, Section A is a menu bar consisting of four sections:

1. Icon of detailed information of the student's grades

2. Student Session History Icon

3. The full name of the student.

4. The name of the degree you are studying.

5. Icon named settings. The functionality of this icon, among other things, is to show and hide the complexity of each of the subjects.

Section B shows or breaks down all the subjects of the grid that the student is taking, as well as each of the grades that she obtained in the subjects that are already underway. The last grade obtained in the subject can be seen in the lower right part of each subject, whether they have passed or not, while the previous grades are in the lower left of each subject in a red circle indicating that they failed. Additionally, two more colors were added to the status bar of each subject, the first is black, which indicates that the student is in a higher cycle but the subject is in a lower cycle and has not yet taken, and the second color added is orange, which indicates that the student is currently taking the course. Additionally, when clicking on a subject that has already been taken and has passed or not, a popup will be displayed with a histogram comparing the student's grade with the grades of their peers, as well as the student's grade and, a bar at the bottom of said popup with the pass or fail color according to the last time you took the course.

Finally, section C shows the graph of the student's performance during her career. We can differentiate two types of graphs and separate them into sections for a better and faster understanding of the user. On the left side, we have a type of line graph in which each point represents a semester completed. The blue lines and dots show the grade averages of all the subjects for each period or cycle that the student attended, while the black lines and dots show the grade averages of all the subjects for each period or cycle that the student's classmates took, these averages are shown at the top or bottom of each black point. With this, we can make a comparison between the student's averages in each semester with the averages of her classmates in the same semesters and classrooms. On the right side, there is a section composed of squares that represent the courses that a student has taken in each academic period in which she has enrolled. Each of the squares is a subject taken, and their position indicates the academic period or semester in which the student took the subject. Also, we can differentiate whether or not said subject passed according to the background color of the rectangle (green for approved, red for failed) and, in addition, within it we have a number, which indicates the number of times the subject was taken. By placing the cursor over any of the rectangles, the corresponding subject will be highlighted in the study plan.

In the lower left part of the display screen, we have a switch that allows us to change the view from courses to workload and vice versa. By clicking on this switch, all the subjects that the student has already approved or cannot take due to lack of approval of required subjects are immediately disabled, in addition, the graph of Comparison of averages by academic period described above disappears and a new one called Weekly workload hours. The operation of this new view is simple, as it is a simulator of what courses you can take the following semester and how many hours of load you will have in all the courses you select; Then, when you click on a subject that, if you can take the next semester, the graph of weekly workload hours will be updated, adding the hours of the selected subjects. In addition to this, the weekly load hours are categorized by practical, theoretical, and autonomous hours, in order to provide better understanding to both the user and the student in the counseling session (Figure 3-24).

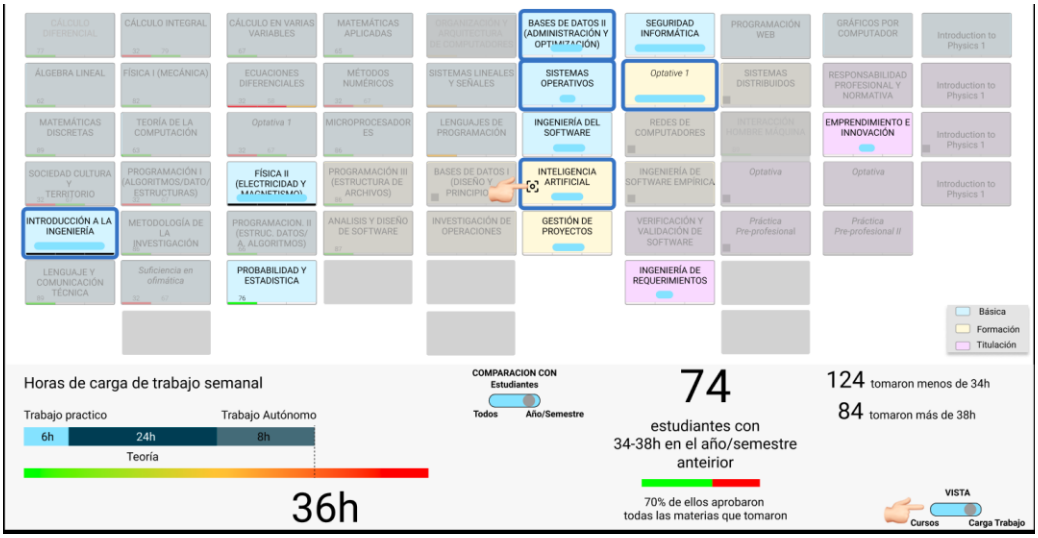


Figure 3-24. Workload view

It also shows the number of students with the same selected workload and how many passed and failed the subjects for that weekly workload. Finally, when placing the cursor on a selected subject, a small box will be displayed indicating, among other things, the complexity of the subject.

Finally, Figure 3-25 shows us a second siwtch on the left side, for complexity change. This switch will be used to change between complexity and registration number for the graphic subjects taken per period.

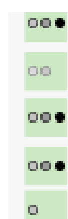


Figure 3-25. Complexity view

The complexity is represented as follows (see Figure 3-25):

- A white circle with a black border: 25%.
- A gray circle with a black border plus the white circle with a black border: 50%.
- A black circle plus a gray circle with a black border plus a white circle with a black border: 75%.

Additionally, and as a very important point, it has been established in these iterations that there is a need to design and implement a tool that is single use for teachers. This visualization panel would allow them to review (through histograms) information of the courses they are teaching, as well as the grades and averages of the students, visualizing them graphically. This, to provide the teacher with a tool in which he can know the performance of either students or the course in general and keep track of the performance of the courses. The general view of the display panel is shown in Figure 3-26. It should be noted that the name used in the figures is fictitious.

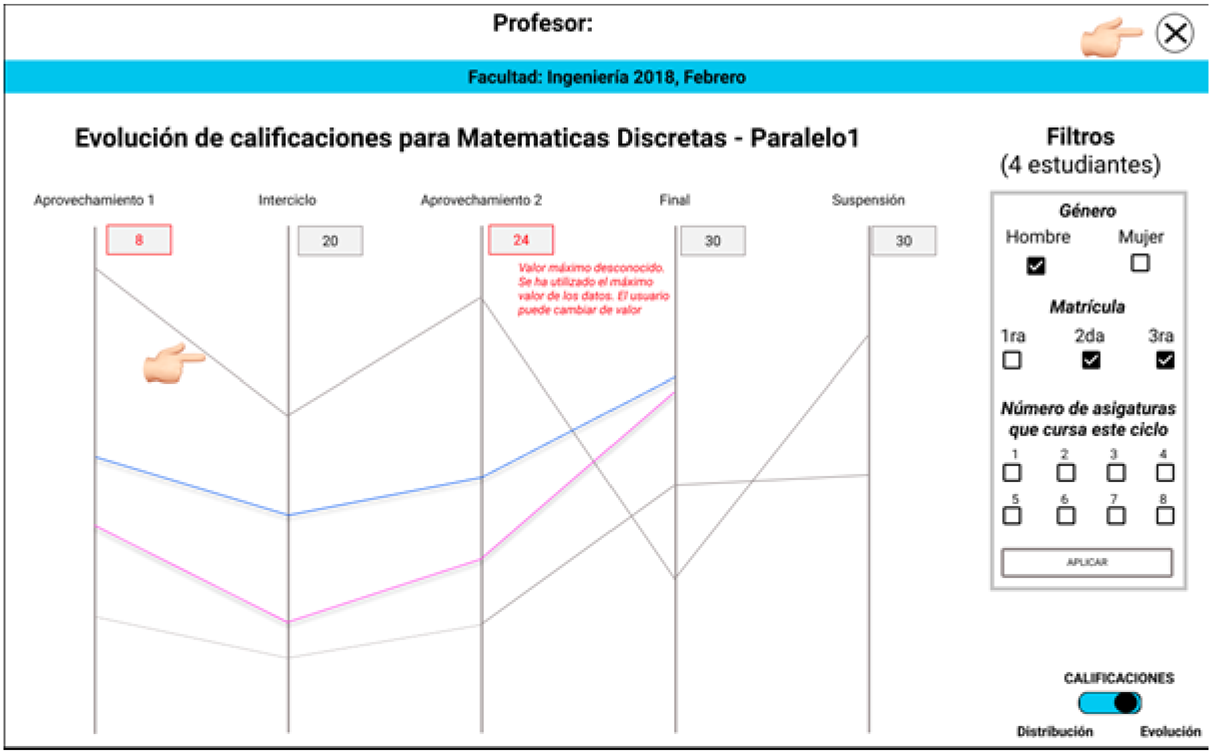


Figure 3-26. First prototype of visualization dashboard for teachers

The tool consists of two different views for the teacher: main view, in which the teacher can view all the courses he is teaching with a histogram for each course in which the averages of each student and the general average of all Classroom.

Also, a selection bar is presented in the lower part of the main view, in which you can choose a variation of the histograms for the qualifications, which can be these: Accumulated, Achievement 1, Intercycle, Achievement, Exam and Suspension.

In the main view, if the teacher clicks on a histogram, a new view will be presented in which the evolution of the students in the subject is presented through a graph of parallel coordinates, as shown in Figure 3-27.

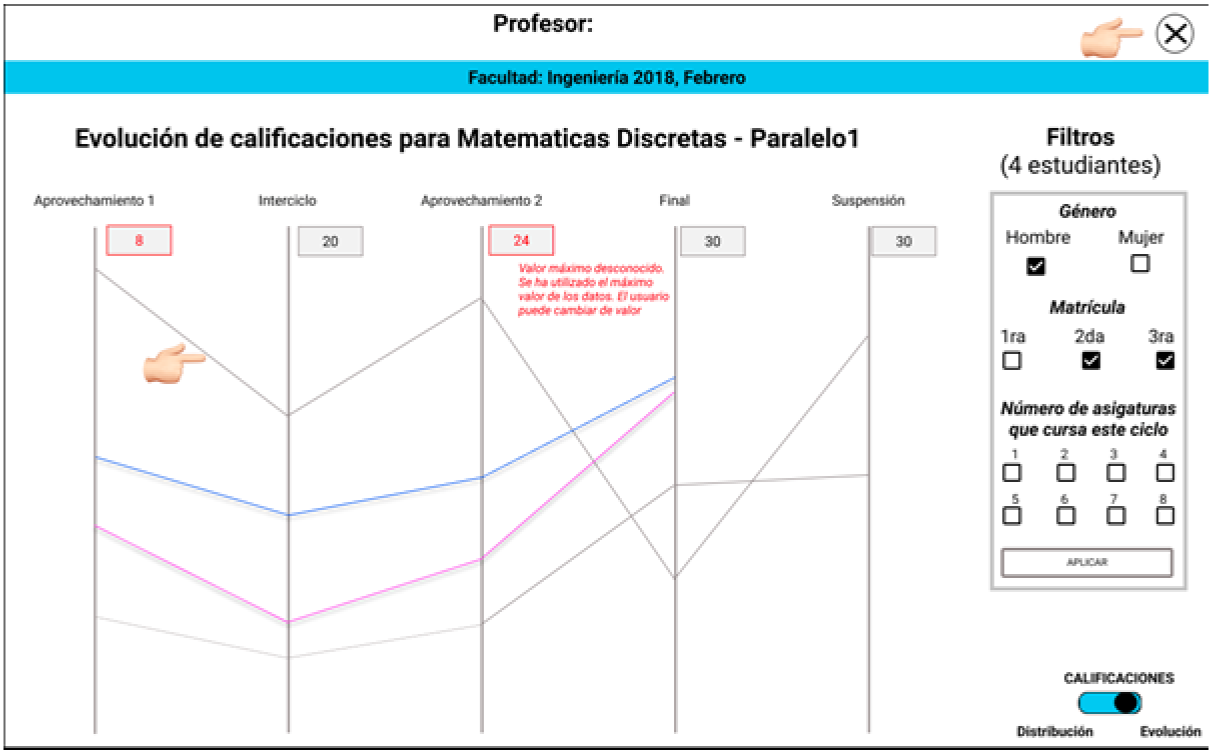


Figure 3-27. Grading evolution

In this view, you can also choose or filter the graph according to the gender of the students, the enrollment number, and the number of subjects they are taking in that semester (Figure 3-28).

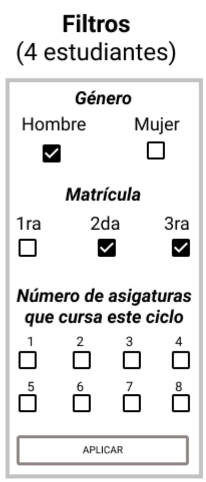


Figure 3-28. Grading evolution filter

3.2.3.1 Version based on pilots and experience

During the execution of the pilots, meetings were held with the users where proposals for improvement of the tools were collected, as well as the correction of errors found. In addition, special cases of cancellation and withdrawal of subjects by students were identified, these special cases varied from faculty to faculty depending on how each of the faculties executed the academic processes, sometimes even by degree program. In addition, the tool was adapted so that the visualizations are dynamic in terms of the grade structure for each of the university's faculties, so the change that was made in the counseling tool is the window in which it is presented the detailed information of the selected course, since the names of performance 1, performance 2, intercycle, etc., will vary according to the way each of the faculties is graded. Although the new design of the tool is quite similar to the first version, several improvements have been made. These include minor corrections and some additional functionalities that are detailed below:

The date of the last migration of the data carried out is shown, in order that users are aware of it. This is shown when displaying the information submenu (Figure 3-29).

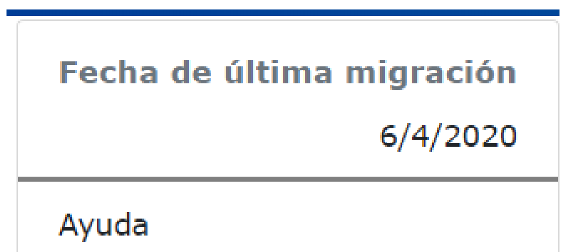


Figure 3-29. Last migration date

A panel (popup) is shown in which a video of the use of the tool is presented, this in order to familiarize the user with all the functionalities that the tool has. (Figure 3-30)

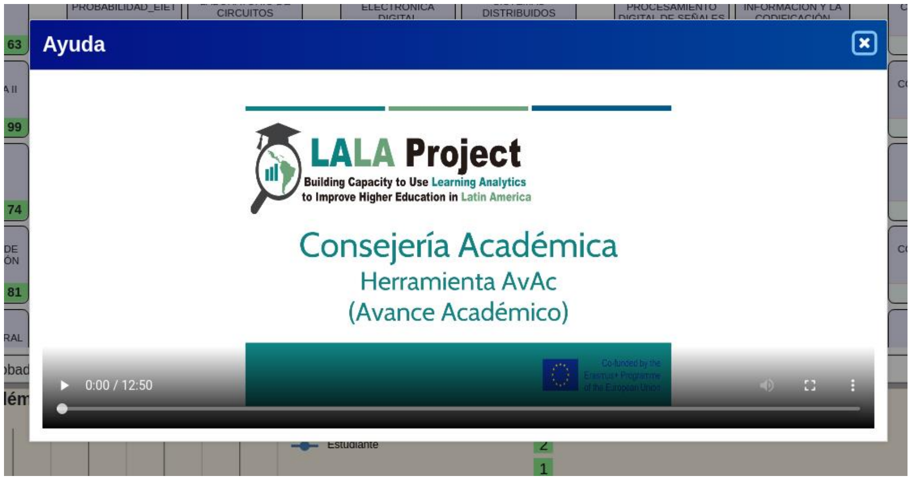


Figure 3-30. Popup with Help Video

A panel (popup) is displayed in which a question is presented with three mandatory response options to the user when conducting a search for a student. This question describes why the user is viewing student information (Figure 3-31).

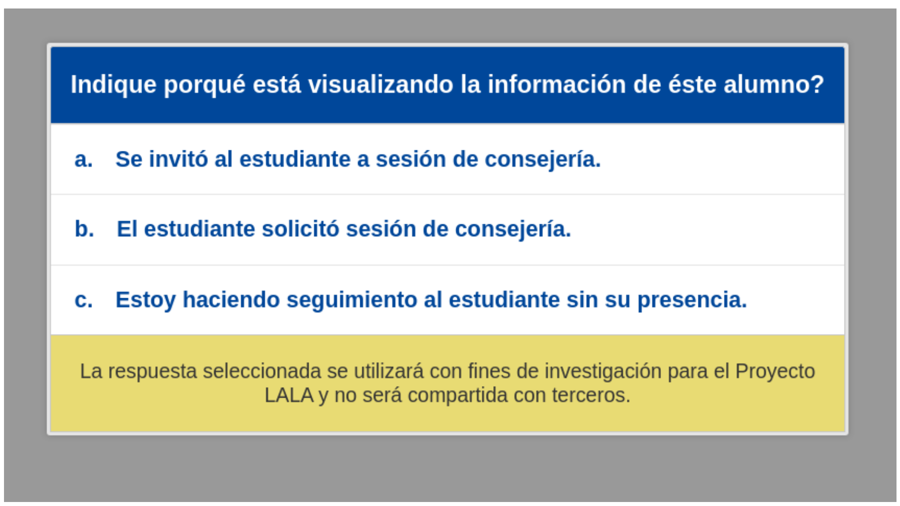


Figure 3-31. Popup with compulsory question why you are analyzing the student.

The color of the base bar of the pictures of the subjects for which the student is studying was changed, from blue to brown, this, in order to provide a more striking view for the user and maintain a structure of contrasts that go hand in hand with the pass and fail colors (Figure 3-32).

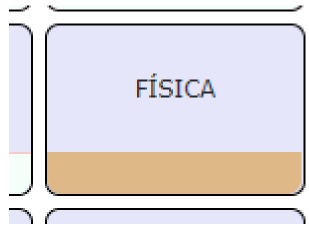


Figure 3-32. Current course taken

The grades in the tables of the subjects that the student has failed are now shown within a circle with a red background and the grade obtained in white (Figure 3-33).

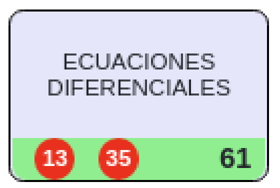


Figure 3-33. Presentation of failed subject grades.

For subjects in which there are only records of second or third enrollment, the grades with which you have failed are presented with the sign of? which indicates that at some point and in some course the student took the course and failed it. If there is a second registration registration, only a failure circle will be presented with the? Sign, in the case of only having a third registration registration, two circles will be presented with the? Sign. A tooltip is added to these circles in which it is indicated that there are no records for the course grid in first or second enrollment, but that you can review the other meshes that the student has completed (Figure 3-34).

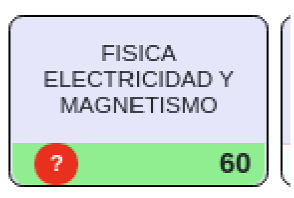


Figure 3-34. Presentation of failed subject without registration.

Tape type labels were added in the upper left part with a gray background and white font for each of the subjects that the student has canceled or withdrawn, placing the legends of A (for canceled), and R (for withdrawal) (Figure 3-35).

Figure 3-35. Subject tag canceled.

A tooltip was added to the nulled and Failed labels indicating the number of times (Figure 3-36).

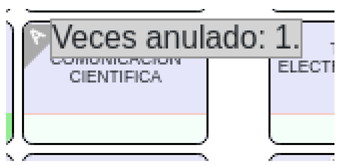


Figure 3-36. Tooltip in subject nulled.

The user is allowed to view information on the period in which they have failed a course by clicking on a grade where they have failed, unlike the previous version that could only view information on the last time they took the course. The following image shows the subject Differential Equations, selecting the 35 qualification that was presented in Figure 3-37.

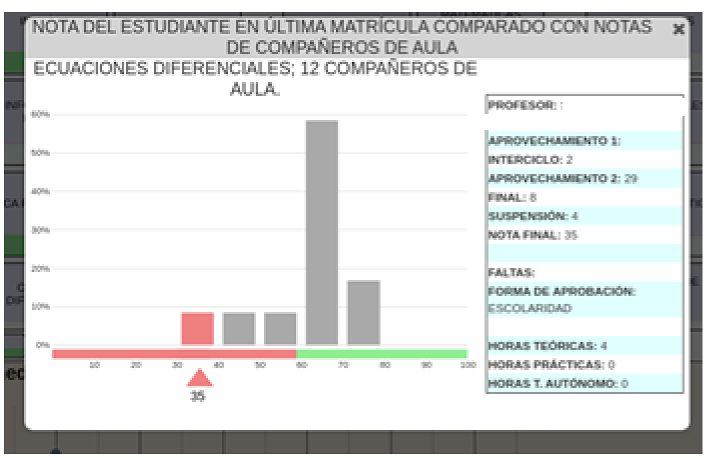


Figure 3-37. Histogram of the academic period of the failed subject.

A panel (popup) is displayed in which the information presented in the tool (legends) is presented in detail (Figure 3-38).

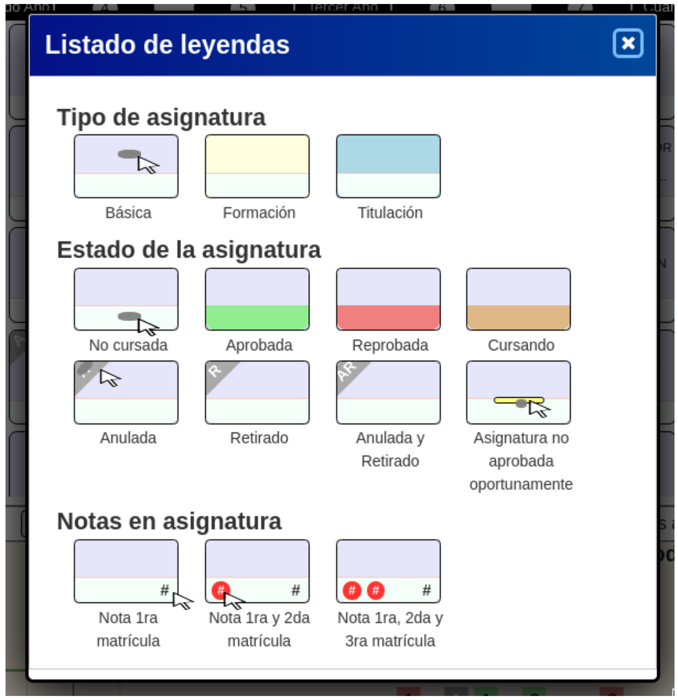


Figure 3-38. List of dashboard legends.

A vertical bar was added on the left side of the screen in which three different options can be chosen: Courses, planning, grade probability (Figure 3-39).

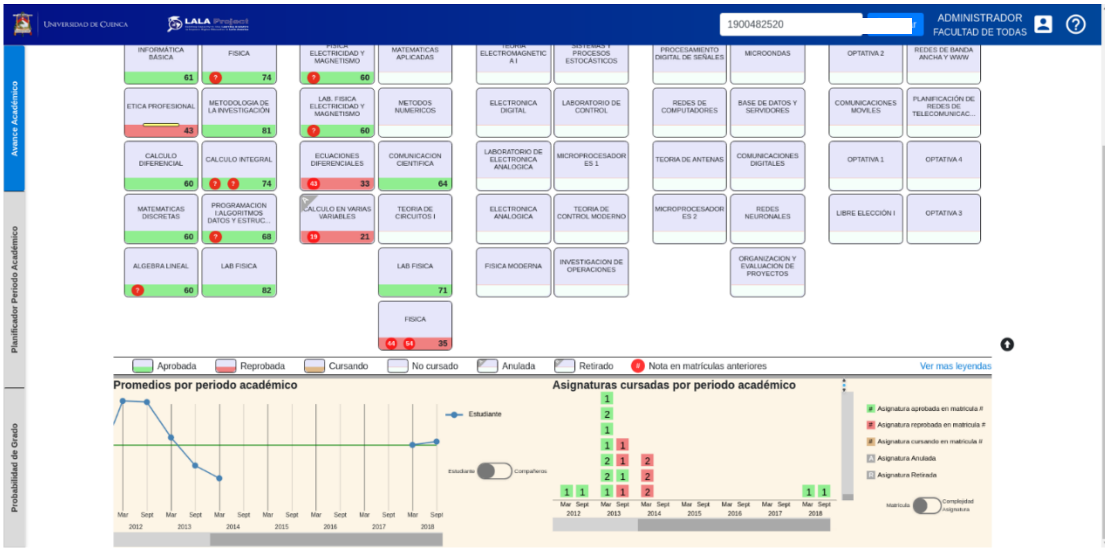


Figure 3-39. Vertical options bar on the dashboard.

Now the study path in which the student has taken subjects that do not belong to his career or to the meshes of his career are also presented (Figure 3-40).

Figure 3-40. Study path outside the student's career

The prediction display can no longer be accessed from the Student Information dialog, but from the main interface (Figure 3-41).

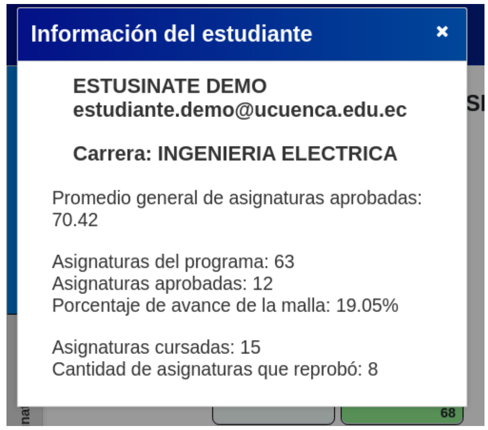


Figure 3-41. Student Information Dialog.

Update of the visualization tool of academic performance of students for teachers

In the exclusive visualization tool for teachers, some changes and improvements have been made to better present the information to teachers and make it more understandable for them (See Figure 3-42).

Figure 3-42. Teacher dashboard

An information box has been added about what is presented in the visualization, as well as what can be done in it. A filter has been added in which you can choose the different periods in which the teacher taught. In addition, a filter has been added in which you can choose if you want to view the histograms of subjects by groups or by careers. The filters to choose the type of qualification to display in the histograms, moved to the top of the histograms below the filters described above. Additionally, the histograms have been ordered according to the average of each one, from highest to lowest.

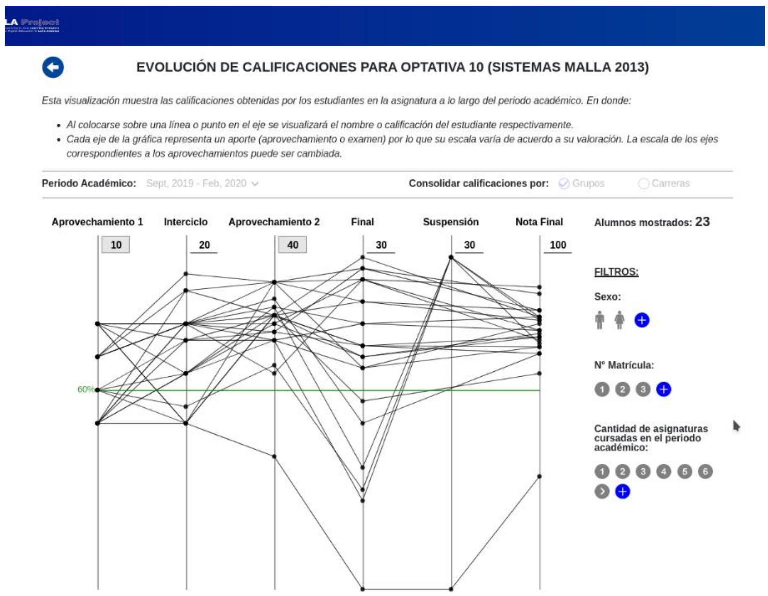


Figure 3-43. Second visualization

In the second visualization (see Figure 3-43), an information box has been added about what is presented in the visualization, as well as what can be done in it. A parallel coordinate graph has been added where each of the lines indicates a student, and each axis of the graph represents a type of grade (Achievement 1, Intercycle, Achievement 2, Final, Suspension, and Final Grade). In addition, a filter was added, in which the teacher can filter the graph for male or female students, for those who are doing first, second or third enrollment, and for the number of subjects they are studying.

Finally, a table was added below the graph, which contains the information of the students who took the selected subject (Figure 3-44).

Detalle de calificaciones de los estudiantes

Nombre	Aprovechamiento 1	Interciclo	Aprovechamiento 2	Final	Suspensión	Nota Final	Sexo	# Matricula	# Cursos	Faltas
	7	16	33	21		77	HOMBRE	1	6	
	6	15	33	22		76	HOMBRE	1	4	
	8	16	34	24		82	HOMBRE	1	6	
	5	10	33	17		65	HOMBRE	1	5	
	8	16	31	29		84	MUJER	1	5	

Figure 3-44. Table with the students who took the course.

3.3. NMP LA Tool at Pontificia Universidad Católica (PUC)

NMP (NoteMyProgress) is a mentoring tool designed to support students' self-regulation strategies in online courses in an automatic and personalized way (http://tech4dlearn.com/index.php/notemyprogress/). Through interactive visualizations, it offers actionable aggregate information about the activity of the students in the online course and their interaction with its contents. The objective is to promote students' reflection on their learning strategies in order to motivate informed decision-making to improve their performance. Specifically, the tool has functionalities to support the following learning self-regulation strategies, such as: (1) goal setting and strategic planning, (2) time management, (3) self-monitoring, (4) self-evaluation. , and organization (take notes). All these strategies are related to the self-learning capacity that students are expected to develop throughout their careers to become professionals capable of training throughout life.

Although the tool was initially designed to be used on Coursera. NMP has an easily adaptable architecture to be used in any other Learning Management System (LMS), such as Moodle, for example, in order to support traditional or blended learning practices. Specifically, the tool consists of a web platform and a plugin for Google Chrome. The plugin is responsible for collecting the student's activity on the LMS and offers the student the option of taking notes while studying the course. The web platform offers the visualization of the student's activity in a graphic and interactive way to facilitate the monitoring of their activities.

The NMP backend is made up of the database and a web processing engine that allows the URLs captured by the NMP plugin to be stored and classified during the student's study session in the LMS. This section presents the NMP database model. Some of these tables should be modified if you want to adapt the tool to a different LMS than Coursera. The tables to be modified are indicated in the description of the database model that is presented below (See Table 3-9).

The student data model is stored in a PostgreSQL 9.5 database. The data model currently defined collects information in real time on the activities carried out by the student during a study session (sequential activities with a time difference of less than 30 minutes), and information provided by the LMS (courses, student events in the current edition and in previous editions). The details of the most relevant tables of the data model are presented below. Some of these tables should be modified to fit a different LMS than Coursera.

Name	Data stores
LearningManagementSystem	LMS data where NMP will be deployed.
Membership	Data of the LMS in which a student is enrolled, as well as the unique identifier in said LMS.
Course	Information about the LMS courses in which you want to use the NMP tool to support the student.
Edition	Data on the editions of the course in which NMP is deployed.
user	Data about users who use the NMP tool
Resource	Data about the learning resources or activities that make up a course.
Note	Data on the notes taken by the students.
Enrollment	Data on students enrolled in a course edition.
Session	Data about students' study sessions in a course.
SessionResource	Data about the resources a student used in a study session.
ResourceStatus	Data on the goals set by the students for each week.
Goal	Data about the resources that are initiated and completed by the student during their study sessions
GoalDetail	Data on the detail of the days that the student planned to achieve her goals.
GoalKpiGroup	data on statistical data presented to the student during their planning to support the strategic planning of new goals.
ResourceActivityDatum	data on the resources used by students in previous editions of a course.
SessionDatum	data on the resources used by students in previous editions of a course.
StudentDatum	Data on the resources used by students in previous editions of a course.

Table 3-9. Description of the database tables

To guide the design of NMP, we followed the Design-Based Research (DBR) methodology (Reimann, 2011). This methodology combines empirical research on education with theories oriented to the design of learning environments. The phases of this methodology are: analysis, design and implementation and evaluation. In addition, this methodology is easily aligned with the dimensions (Institutional, Technological and Ethical), defined in the LALA Framework.

This section presents a detail of the NMP functionalities offered through the plugin for the Google Chrome browser and the web display panel. For the visualization panel, the detail of each of the visualizations designed to support students' self-regulation strategies is presented.

NoteMyProgress plugin

The plugin supports students' self-regulation strategies while they carry out their learning activities in the LMS. Specifically, the plugin allows students to monitor (Self-monitoring) and become aware of the time spent during their study sessions (Time management). Figure 3-45a shows the visualizations about the time in session that are presented to the student. In addition, the plugin allows students to take notes on the course material (Organization). Figure 3-45b shows the main interface of the notepad.

Figure 3-45. Plugins visualizations and notebook interface

NoteMyProgress display panel

The NoteMyProgress display panel provides an interface to support students' self-regulation strategies outside of the LMS. The visualization panel offers three main functionalities (see Figure 3-46): (1) Monitor their learning process, the student can self-monitor and become aware of their learning process in the course through interactive visualizations; (2) Manage and take notes, the student can manage the notes taken from the NoteMyProgress plugin and create new notes; (3) Goal planning, the student can define his own learning goals for each week of the course.

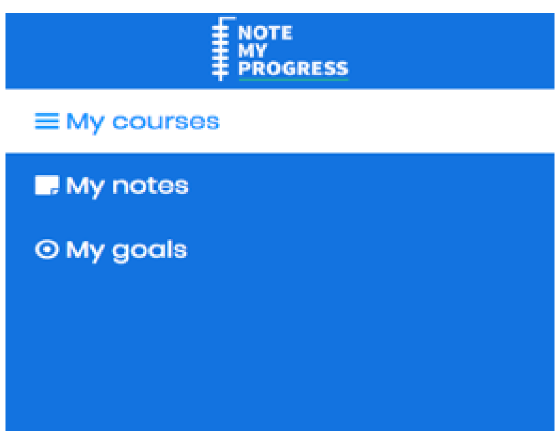


Figure 3-46. Menu Options in the NoteMyProgress display pane

Goal setting functionality

The goal definition module allows the student to define his personal goals for each week of the course. This functionality is intended to make students reflect on their degree of commitment to the course and the time available to achieve their individual goals. Figure 3-47 shows the interface for defining student goals. First, the student selects the course and week for which she wants to define her goal. Then the student selects the day or days that she plans to carry out her study sessions. Finally, the student enters the number of hours that she plans to invest, the number of videos to watch, and the number of evaluations to take.

To support the strategic planning of students when defining their goals. NoteMyProgress presents a set of indicators on student performance in the week prior to the study week that the student is planning. Specifically, information is offered on their general performance in the course so far, on the activities to be carried out in the week that they are planning and the performance of other students who completed the course in previous editions (see Figure 3-48). The objective of these indicators is for the student to become aware of their previous performance and that of other students who have won the course in previous editions, to plan their goals in a more strategic and informed way.

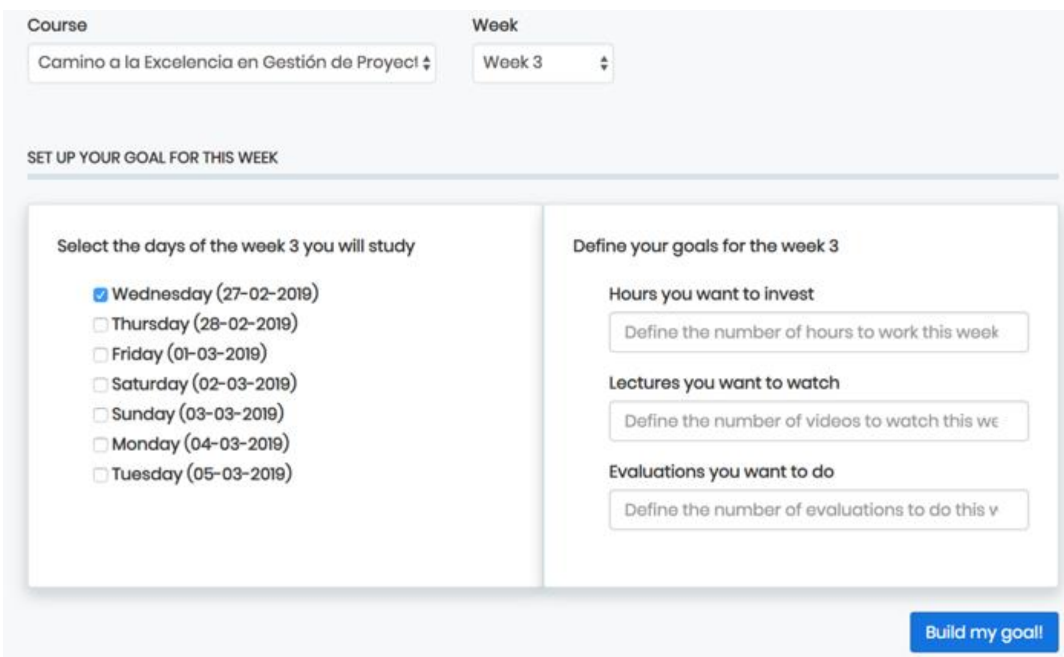


Figure 3-47. Goal Setting Interface

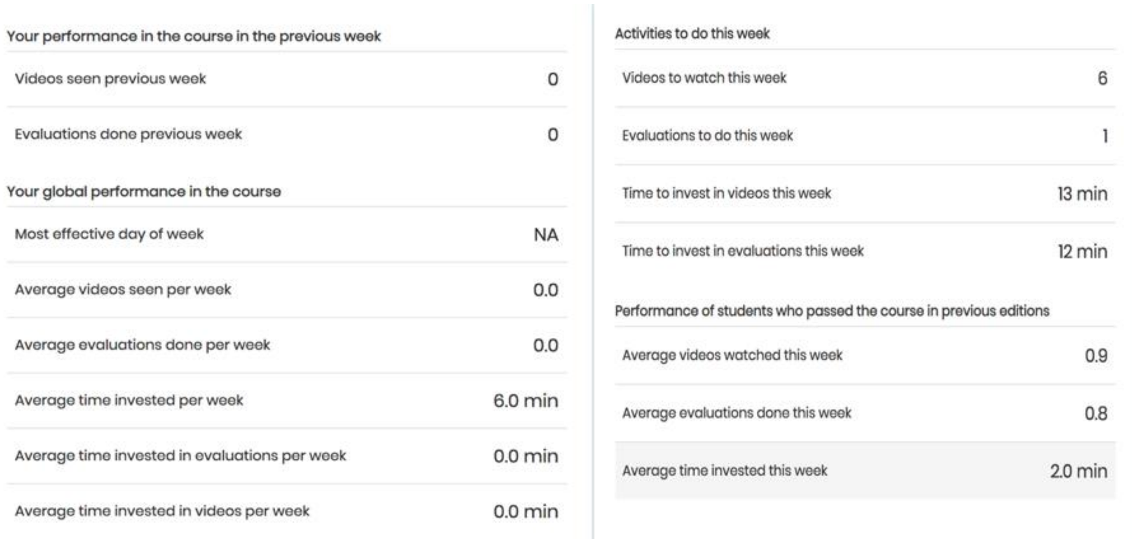


Figure 3-48. Performance metrics to strategic planning

In addition, the Goal Planning module allows students to monitor the fulfillment of the defined goals as shown in Figure 3-49. This figure shows the fulfillment of their goals and also allows them to be compared with the goals defined by other classmates.

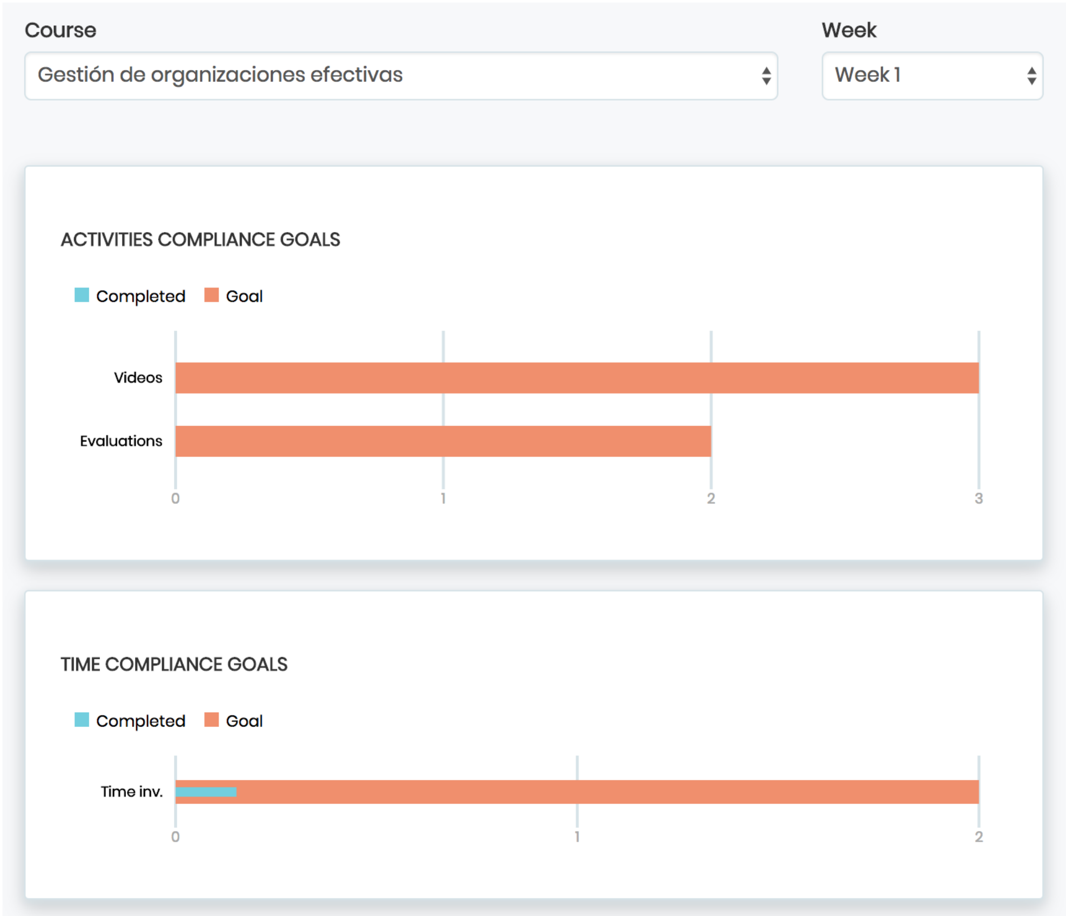


Figure 3-49. Visualization to goal setting monitoring

Notes Management Functionality

The notes management module allows students to manage the notes taken from the notepad of the NoteMyProgress plugin (Figure 3-50). In this module the student can create new notes, as well as search, delete and modify notes taken. In addition, the student has the option of downloading a note or a set of notes in .pdf format.

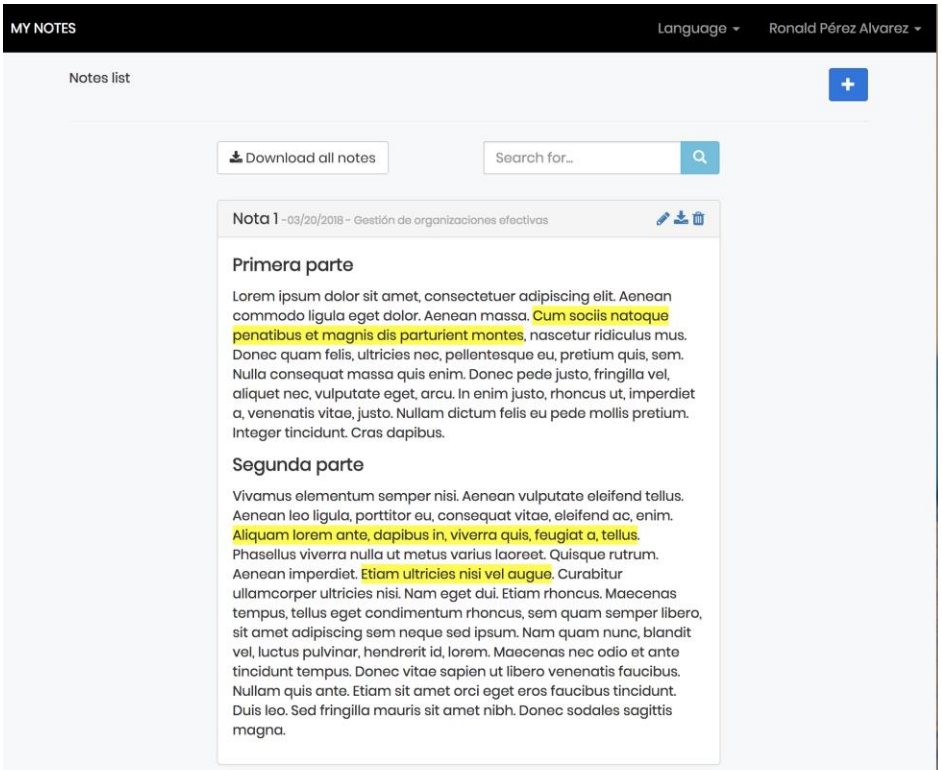


Figure 3-50. Note Interface

Self-monitoring functionality

The self-monitoring module allows students to monitor and reflect on their learning process in the course. This module is composed of two visualization panels that present visualizations about the performance and effectiveness of the students when carrying out the learning activities defined in the course (see Figures 3-51 and 3-52). The visualizations related to the effectiveness of the student allow the student to analyze how effective they have been in carrying out the course activities. The student can compare his time invested in activities with respect to the time required for each activity, the number of activities started with respect to the number of activities completed, know which day and time of the week is more effective completing activities.

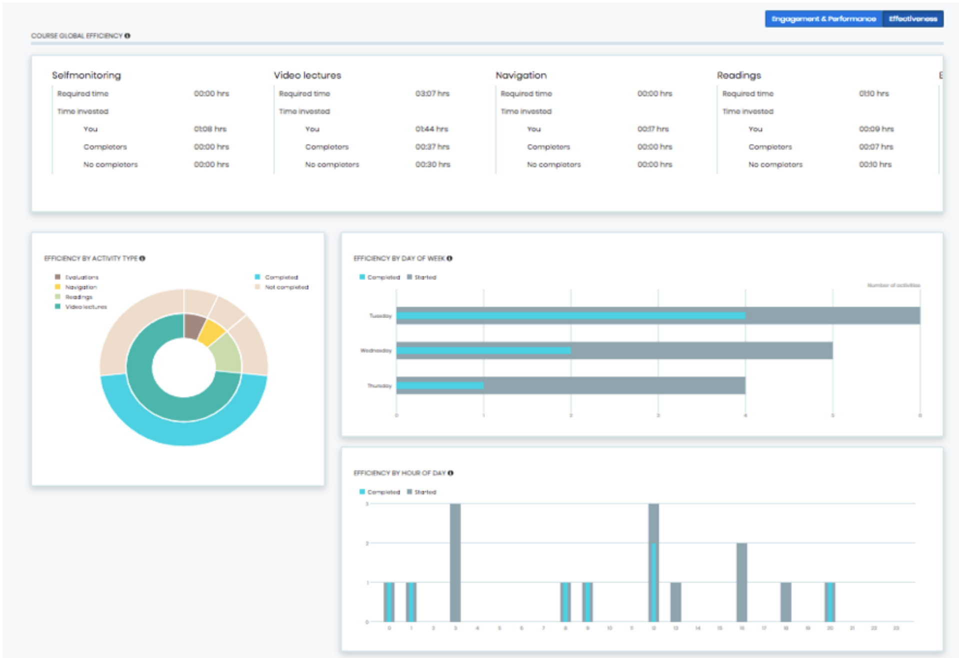


Figure 3-51. Efectividad del panel de visualización

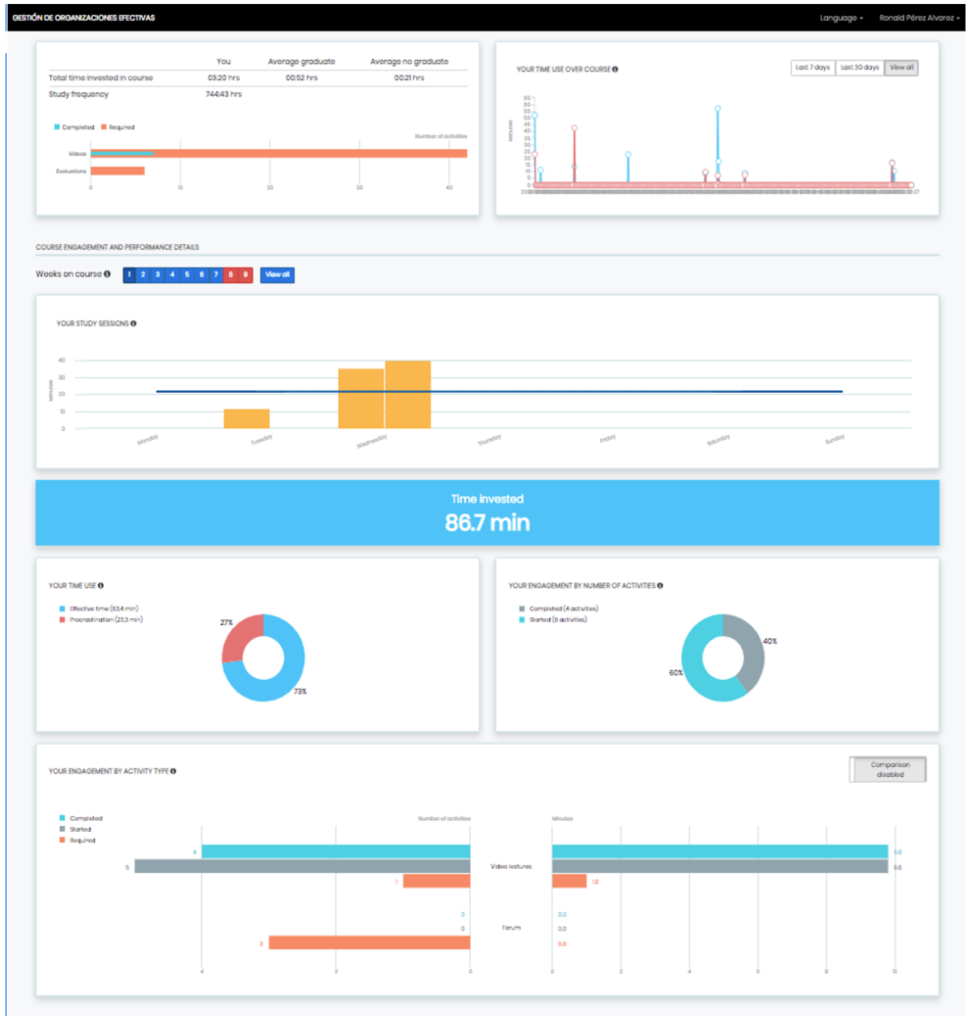
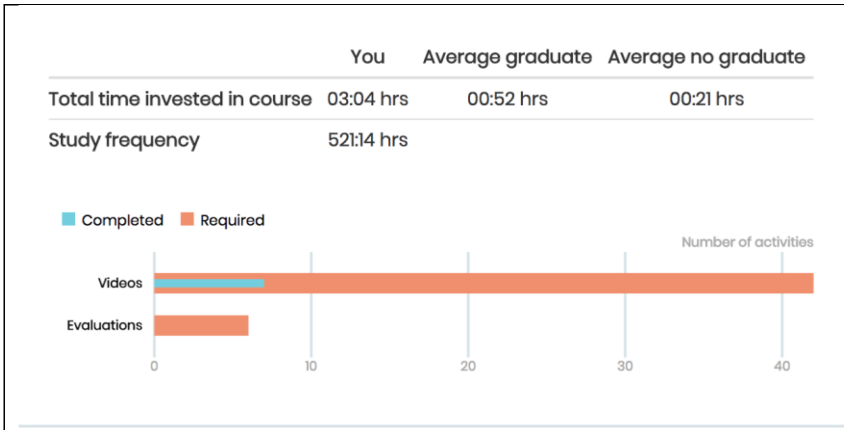
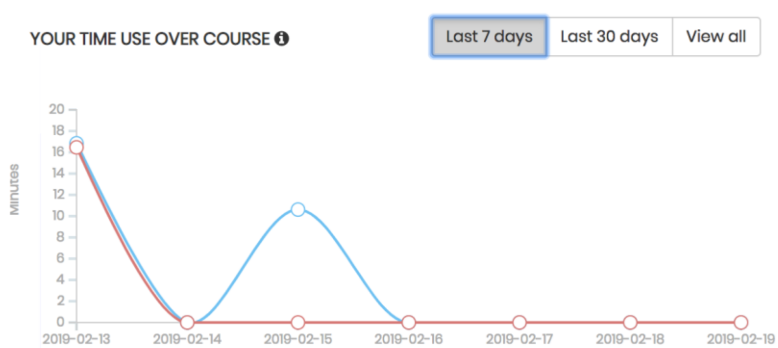
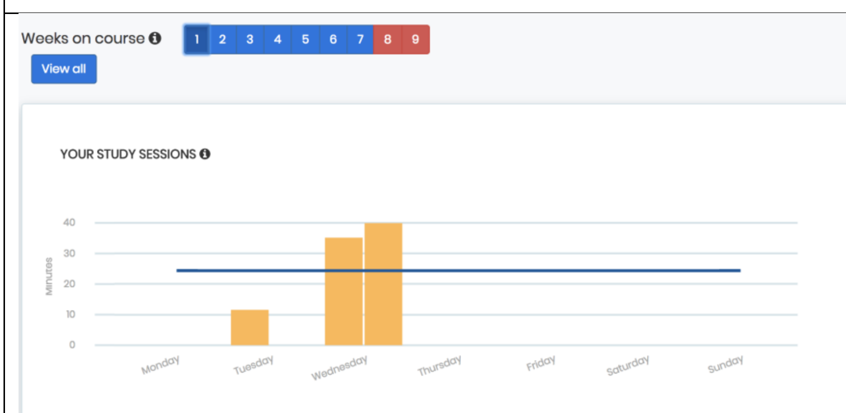
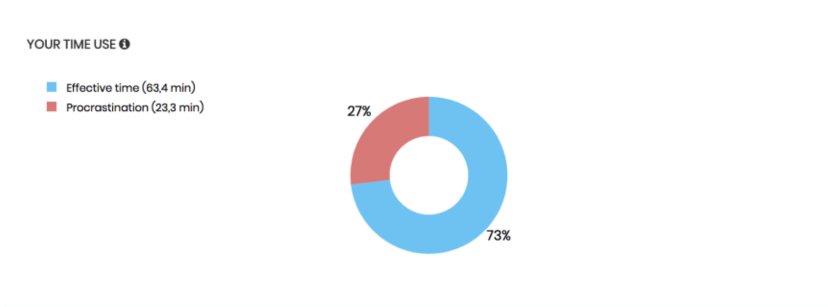
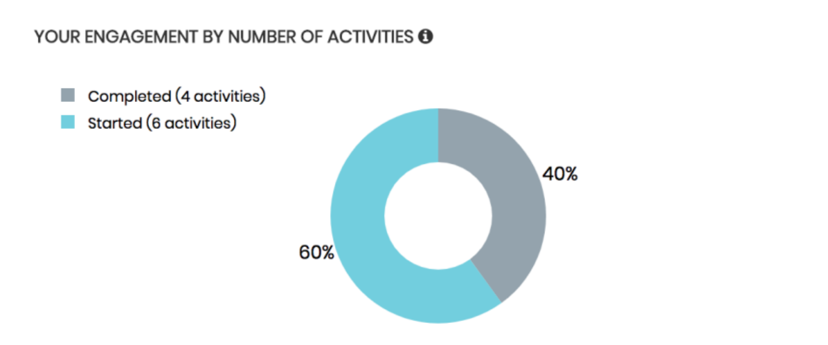
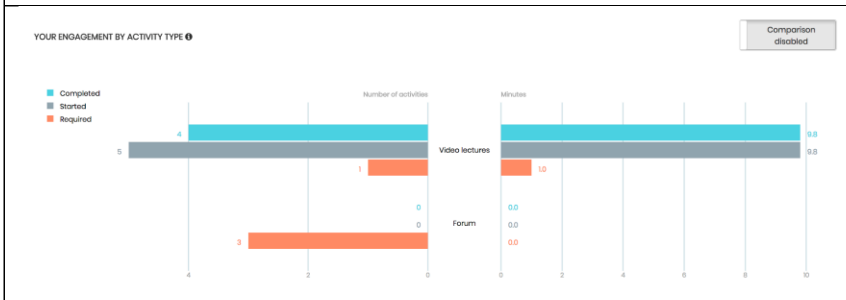


Figure 3-52. Display panel for performance monitoring

Table 3-10. presents the set of visualizations related to the student's performance. Most of the visualizations are interactive, so that the student can analyze the information in detail for periods of time or categories of activities.

Visualization	**Description**

<table>
<tr>
<td>
</td>
<td>This visualization shows the time spent on the student's activities versus the time required by the teacher, the videos completed versus the videos required for that week, the assessments performed versus the assessments required for that week, the frequency of study, and the time spent by other students. in the course.</td>
</tr>
<tr>
<td>
</td>
<td>This visualization allows the student to analyze her performance with respect to the time invested in activities of the course and activities outside the course (Procrastination), during a study session. The student can see her performance for the last 7 days, 30 days or the entire course.</td>
</tr>
<tr>
<td>
</td>
<td>This visualization allows the student to analyze the time invested in the study sessions of a specific week of the course.</td>
</tr>
</table>

	This visualization allows the student to analyze how he has spent her time during the week. The time invested in the activities of the course is compared to the time invested in other activities outside the course (Procrastination).
	This visualization allows the student to analyze how her commitment to the course activities has been. The number of activities started versus the number of activities completed is compared.
	This visualization allows the student to analyze her commitment to the course activities (time invested and activities carried out). The visualization shows the time required to invest and the number of activities to be carried out in each category, the time invested and the number of activities completed, and the time invested and the number of activities started.

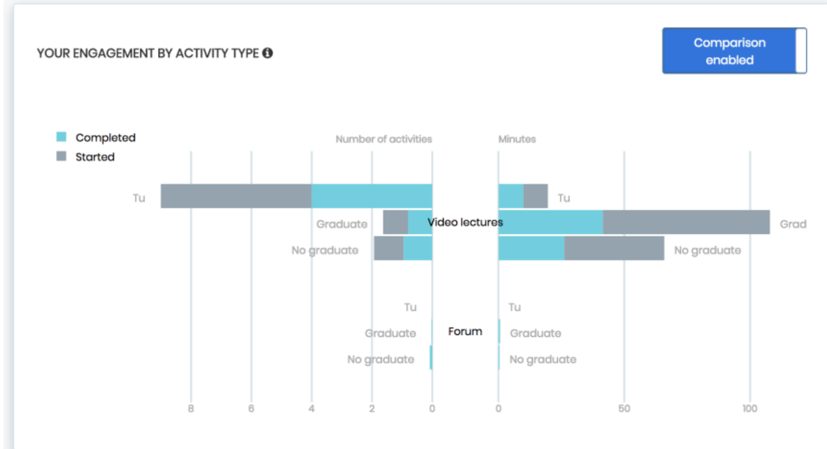
	This visualization allows the student to compare their performance with the performance of other students who enrolled in the course in previous editions.

Table 3-10. Set of visualizations related to student performance

3.3.1.-Version based on pilots and experience

This section presents a detailed description of the NoteMyProgress (NMP) tool adapted for the Moodle platform, presenting a functional dashboard for teachers and students. This development is based on the results obtained from the pilots with NMP used on the Coursera platform for MOOCs and which considered a dashboard only for the student. One of the main results of the pilots with NMP for Coursera showed that one of the greatest difficulties in adopting this tool is, on the one hand, the fact that it was not integrated into the Coursera MOOC platform and, on the other hand, that only few institutions in Latin America have courses on this platform. The need to incorporate a teacher help dashboard into the tool was also detected in the pilots. This part had to include functionalities to manage the course and update its information without the need to modify or execute scripts on the NMP database, as well as offer visualizations about the self-regulation actions carried out by the students. From the results of the pilots carried out, the following requirements were identified:

Develop a version of NMP for Moodle, one of the Learning Management Systems most used by HEIs in Latin America, as it is Open Source. This will improve the long-term adoption of the tool.

Adapt the NMP functionalities that worked in the Coursera version for the students and that gave better results in the pilots. Specifically, that is, adapt the functionalities of time management and planning, resource management, note taking and meta-reflection.

Incorporate a functionality for the teacher to help the student plan the follow-up of the course and see a summary of the interaction and self-regulation actions of the students in each course.

With all these requirements derived from the pilots made with NMP for Coursera, a version of NMP is implemented for the LMS Moodle that includes an interface for the teacher and another for the student.

3.3.2.-Moodle Architecture

NMP Moodle is a plugin that is directly incorporated into the Moodle architecture as a plugin. Moodle's architecture is organized in three layers (Figure 3-53): (1) the user interface (UI, User Interface) layer, (2) a library with PhP functions that are called from the interface and that, in turn , they interact with the database (Libraries, DBL libs, File libs), and (3) a compound database where two elements are stored, the static (DB) and the dynamic (Files moodledata). The NMP Moodle plugin is incorporated into the architecture like any other plugin, adding new files in the general library, and in the Files Moodle data database.

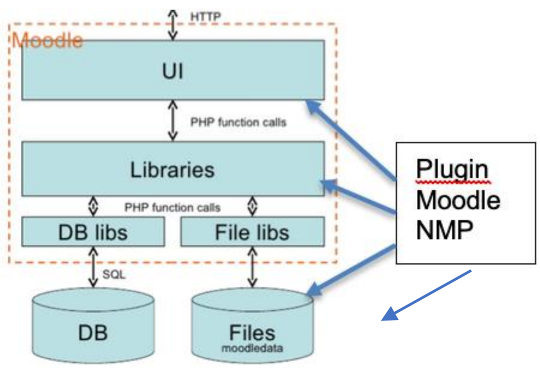


Figure 3-53. General architecture of Moodle and Incorporation of NMP Plugin. Adapted from: https://images.app.goo.gl/snkYiKaTAWSovAUE8

Once installed, Moodle is stored on the server as a set of folders that all start from the root folder. As Moodle is organized in a modular way, in the / mood directory of the installation, there are all the folders corresponding to any installation plugin. For the installation of NMP Moodle, it is required to add and work on these folders.

Access to source repositories

The source code for the installation can be downloaded from the LALA website at the following link: Currently, the plugin exists in two languages, Spanish and French

NMP Moodle plugin database

The Moodle database is structured in a modular way. For each module or activity included, a series of classes are defined that join the set of Moodle classes. On the official Moodle page you can find links to graphical representations of the data schemas of the Moodle platform in its different versions.

Teacher vision

The NMP Moodle plugin is integrated for the teacher as one more option within the course navigation menu (Figure 3-54) called “Reports”.

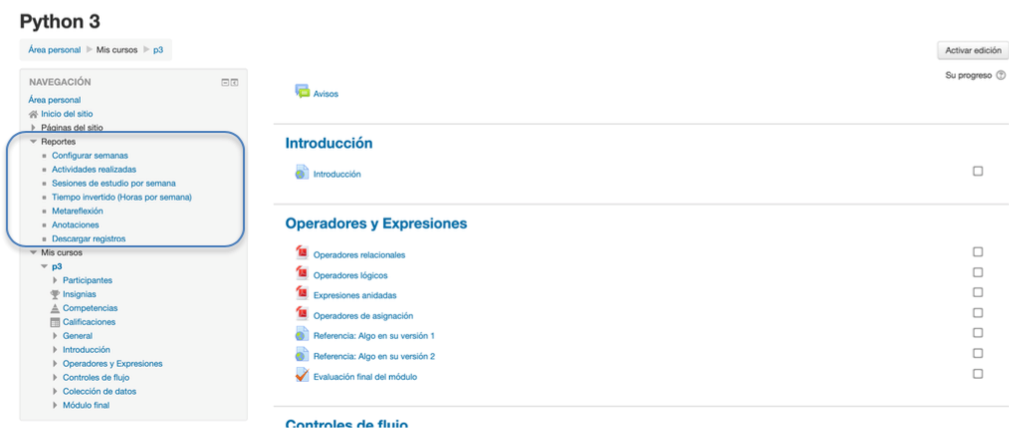


Figure 3-54. Teacher view of the "Reports" functionality that is installed when NMP Moodle is installed.

Within this menu option, 7 functionalities are displayed. Each of them is detailed below.

Set weeks (Figure 3-55). It is used for the teacher to distribute the course resources in different weeks and associate them with an estimated time of work as a reference for the students. The teacher configures his / her course in the different weeks by clicking on the "Add week" button. In each week you must indicate the start and end date, as well as the hours of dedication that you expect from the student. In addition, she can associate to each week the resources that she already has generated in the course from the "Sections available in the course" section to the corresponding week. The association is made by dragging the resource to the corresponding week and will serve to indicate to the students which resources they must carry out each week as a reference to the students.

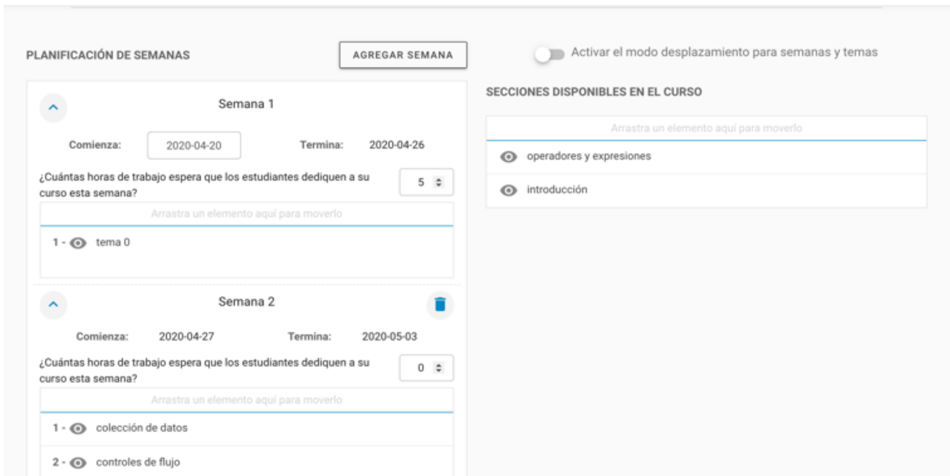


Figure 3-55. The teacher can organize the course in weeks and associate an expected time of dedication for each week. In addition, he can associate course resources with a particular week to indicate to the students which resources they should work on that week.

Activities carried out (Figure 3-56). Provides a visualization of the resources students have worked on. Specifically, it shows the number of interactions that have been carried out on each resource to help the teacher understand which resources have been the most consulted. In addition, by placing the mouse on the column associated with a resource, information about the average of interactions per student is displayed, as well as the average time of said interactions. The top menu allows the teacher to select the week for which she wants to view the information.

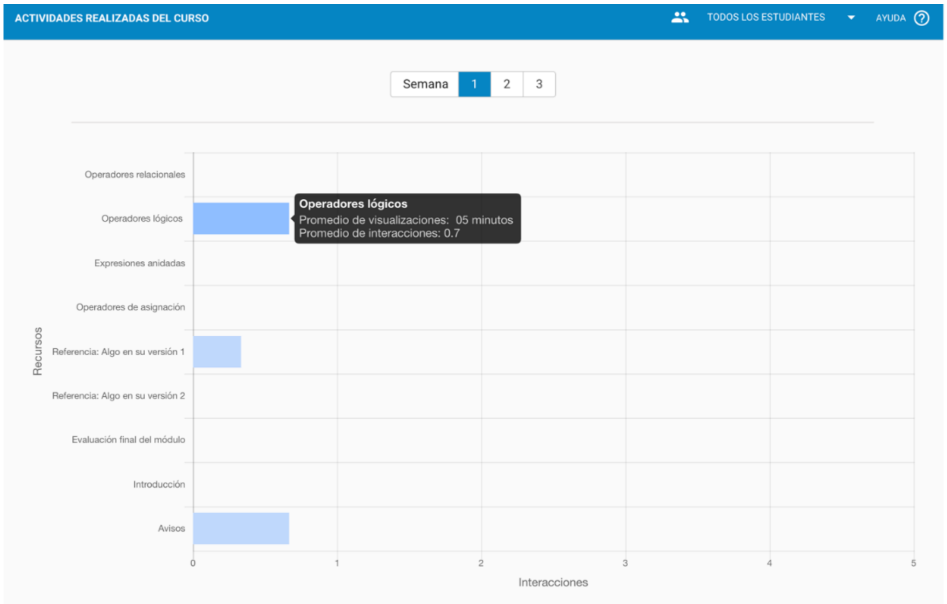


Figure 3-56. Visualization of the activities carried out by the students. The average number of interactions is displayed, as well as the average time of those interactions.

Study sessions per week (Figure 3-57). It offers a visualization of the work sessions carried out by the students in the course. Specifically, it shows, for each week: (1) the total number of sessions carried out that week by the students; (2) the average duration of sessions for that week; and (3) the number of students to whom the listed sessions belong.

Figure 3-57. Visualization of the number of sessions carried out by students in the course per week and main characteristics of said sessions.

Time invested (Hours per week). It offers two different views of the time spent on the platform by students. The first (Figure 3-58) offers a visualization of the average time spent by students during the week in their work sessions compared to the time expected by the teacher (previously defined in their structure of weeks). Hovering the mouse over the columns reports the average time spent per week and the average time expected by the teacher in that week.

Figure 3-58. Time spent by students in their weekly work sessions compared to the time expected by the teacher.

In the second (Figure 3-59), a visualization is offered showing the type of document that has been consulted in the different work sessions by the students at what time it has been consulted. In addition, by hovering the mouse over the type of activity, information on the number of interactions registered for that type of document, the number of students who have interacted, and the average number of interactions on that resource per week are displayed.

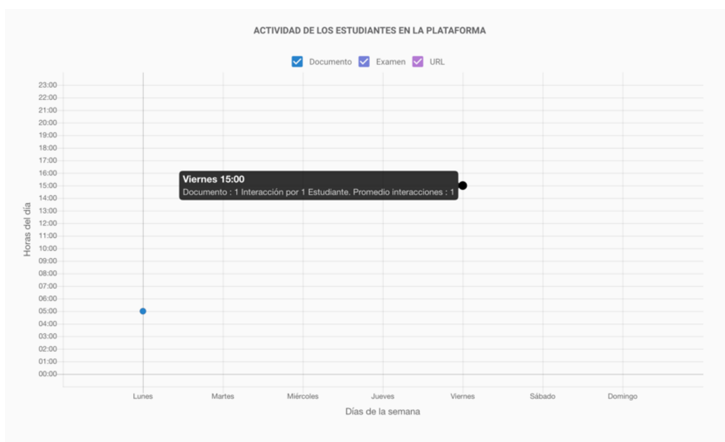


Figure 3-59. Student activity on course resources and the time at which they were consulted.

Metareflection. It shows the aggregated results of the students' responses to the meta-reflection questionnaire (see in the student vision “Meta-reflection” for the details about the questionnaire. Two visualizations are shown in two different tabs. In the “weekly effectiveness” tab it is shown (Figure 60): (1) an overview of the “real” time spent by the students in their work sessions (orange) and a vision of the “desired” time that the teacher had planned; (2) a table indicating the percentage of students who have met their goals for the week (ie on Tuesday, 100% of the students met their planning and on Thursday only 33.3%).

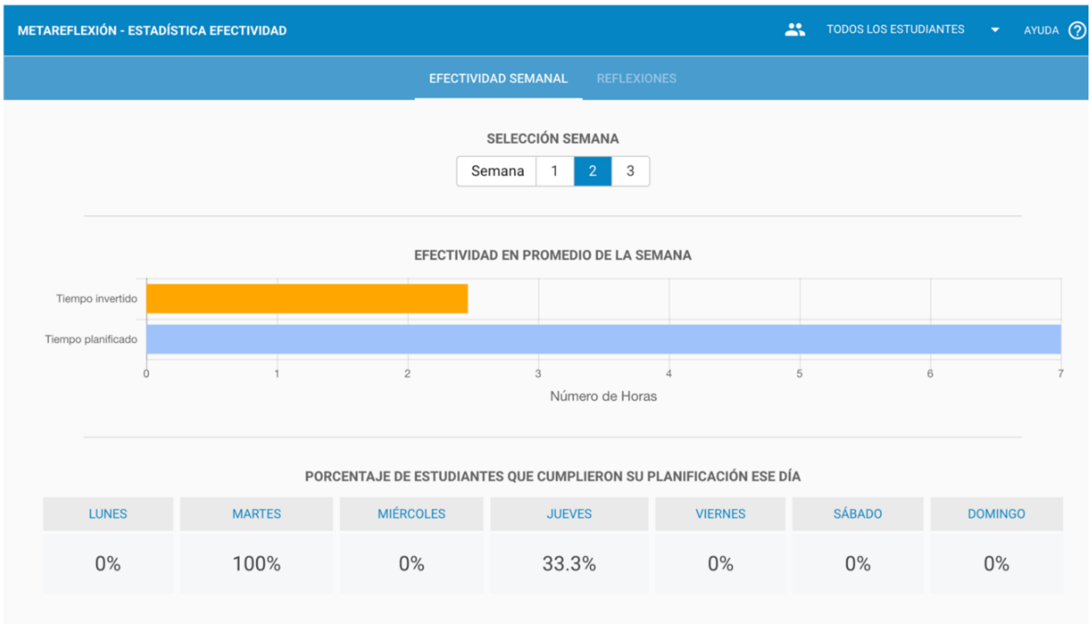


Figure 3-60. Viewing metareflection results, "Effectiveness" tab. It shows the actual time spent by students this week (orange) compared to the time expected by the teacher (blue),

and the percentage of students who have managed to achieve the goals that were planned for that week.

The second tab "Reflections" (Figure 3-61) shows the students' evaluations of the work done this week in relation to the learning objectives and the benefit of the courses.

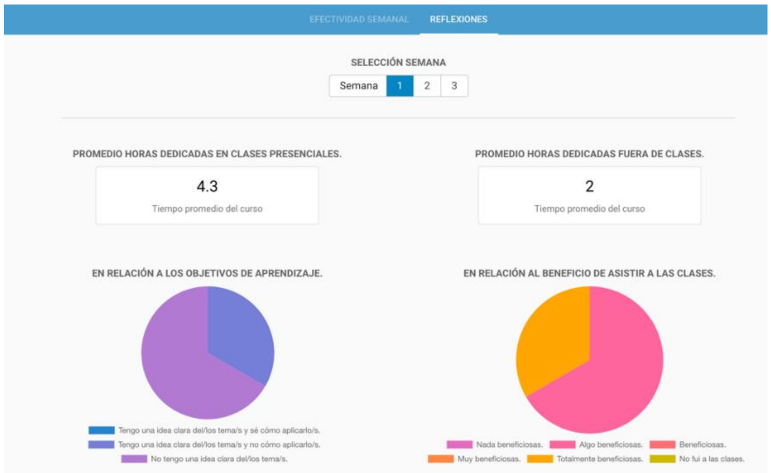


Figure 3-61. Metareflection of the students “Reflections” tab. It shows the evaluations of the students in relation to the work carried out each week, in relation to the objectives of the course and the benefit of the courses.

Annotations. Functionality that allows the teacher to take notes about their course. You can also search and manage the notes issued (Figure 3-62).

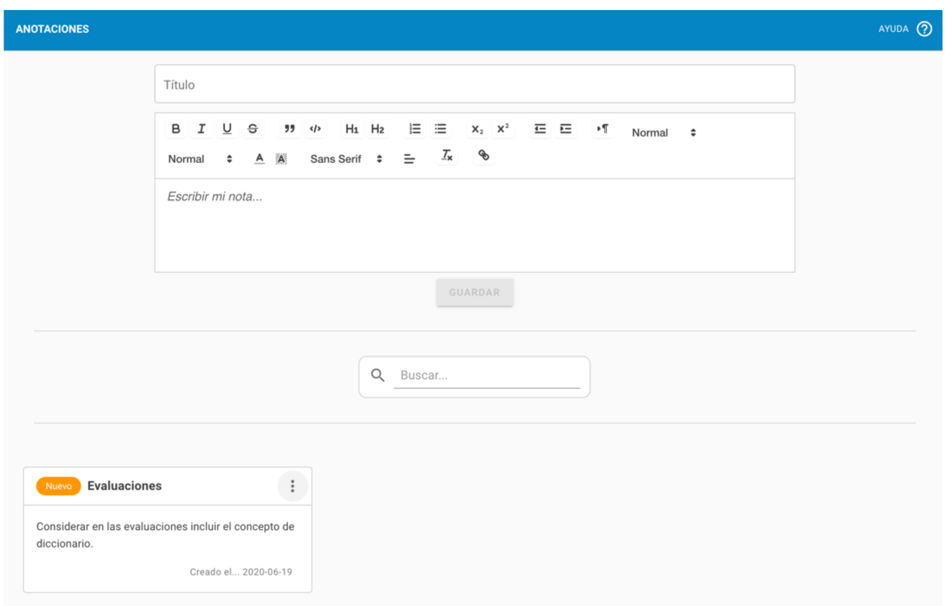


Figure 3-62. Annotations functionality. It allows the teacher to take notes on their course and manage them.

Download logs (Figure 3-63). It allows downloading an Excel file in the form of a logfile that records all the actions of the students on the different functionalities of the NMP Moodle plugin.

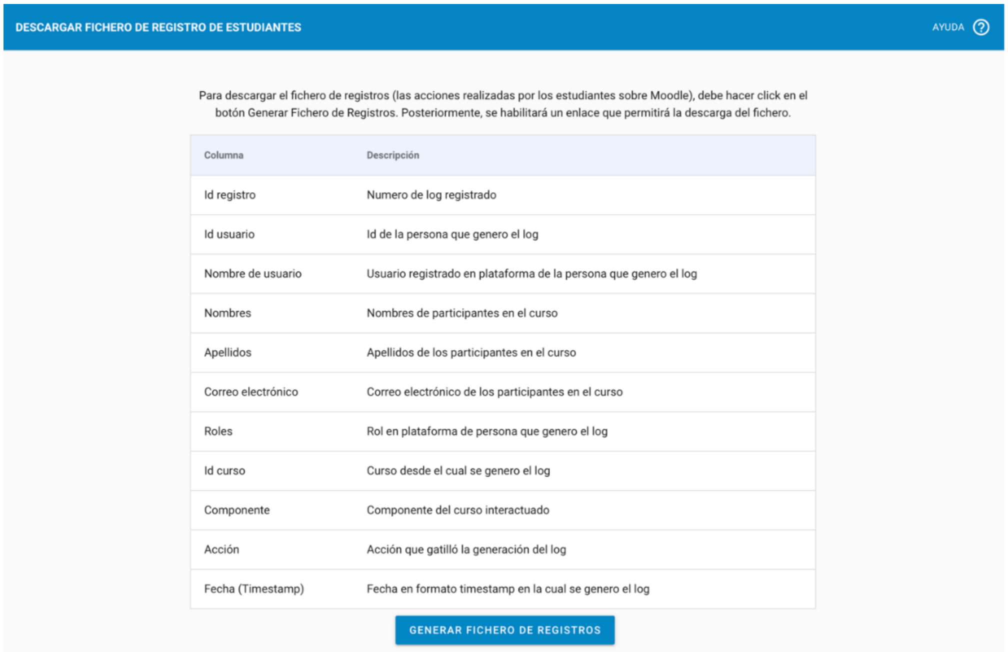


Figure 3-63. Registration. It allows the teacher to download a logile that records the actions of the students on the NMP Moodle plugin.

Student vision

The NMP Moodle plugin is integrated for the student as one more option within the course navigation menu (Figure 3-64) called “Reports”. This section includes the functionalities explained below.

Figure 3-64. View of the “Reports” section for the students. It is incorporated after the installation of the NMP Moodle plugin.

Within this menu option, 5 functionalities are displayed. Each of them is detailed below.

Activities carried out (Figure 3-65). It is used for the student to see her progress in relation to the tasks planned by the teacher for each week. A top bar shows the overall percentage of your progress (44%). In the form of a graph, a graph is shown with the different types of documents or learning resources incorporated by the teacher in the course (X axis) and the amount of each type of resource (Y axis). The amount of pending resources is shown in red and those already made / consulted in green.

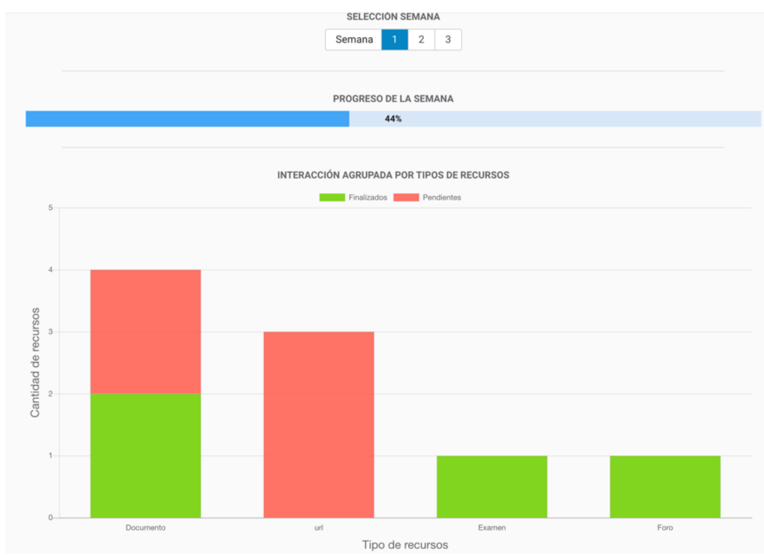


Figure 3-65. "Activities carried out" functionality. Shows the student the resources completed / consulted for the course that week (green) and those that remain to be completed (red). In addition, the total percentage of progress is displayed.

Study sessions per week (Figure 3-66). Shows the student information about the work sessions carried out each week. Specifically, it shows the number of sessions per week and the average time in minutes devoted to work sessions that week.

Figure 3-66. Shows the student the work sessions carried out per week and the average time spent on them.

Time invested (Hours per week). It shows two visualizations: (1) The time invested in the work sessions (orange) compared with the time that the teacher had planned that he should dedicate (Figure 3-67), and (2) a graph indicating the type of resources to which he has dedicated their work sessions, and the average time invested in each type of resource (Figure 3-68).

Figure 3-67. Time spent in work sessions by the student in a given week (orange) compared to the time expected by the teacher (blue).

Figure 3-68. Time dedicated to the different course resources that week.

Metareflection. This is the space dedicated to planning and self-reflection on the work done. It is structured in three tabs:

- **Weekly effectiveness (Figure 3-69),** which shows the time invested in relation to the planned one in the form of a graph and a series of icons that shows if he has managed to meet the learning objectives that he had self-planned this week (carita trise , he has not fulfilled them; green thumb up, he has fulfilled them.

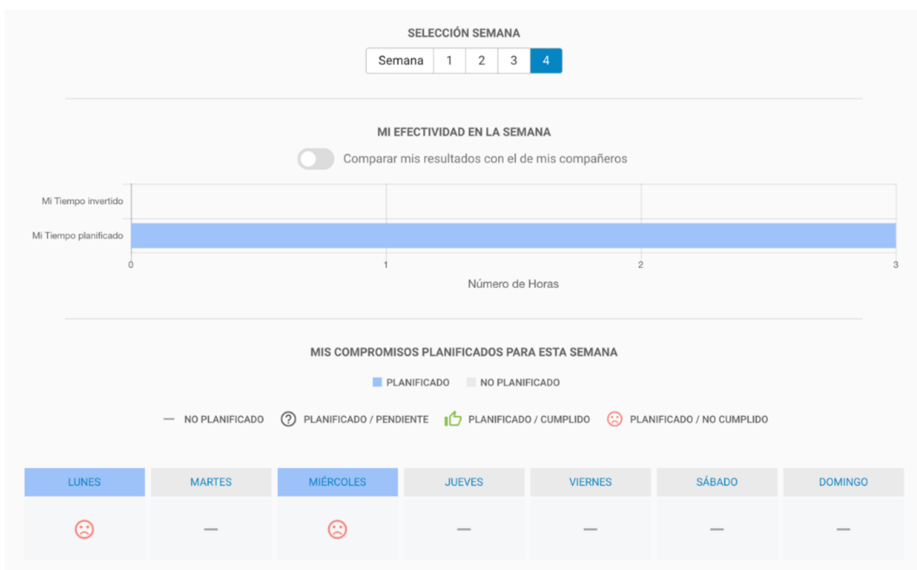


Figure 3-69. Weekly effectiveness. It shows the student the time invested in relation to the planned one and its effectiveness in relation to the work carried out and the planned one.

- **Weekly planning (Figure 3-70),** which allows the student to plan the time that he is going to dedicate to work each day of the week, taking as a reference the times established by the teacher.

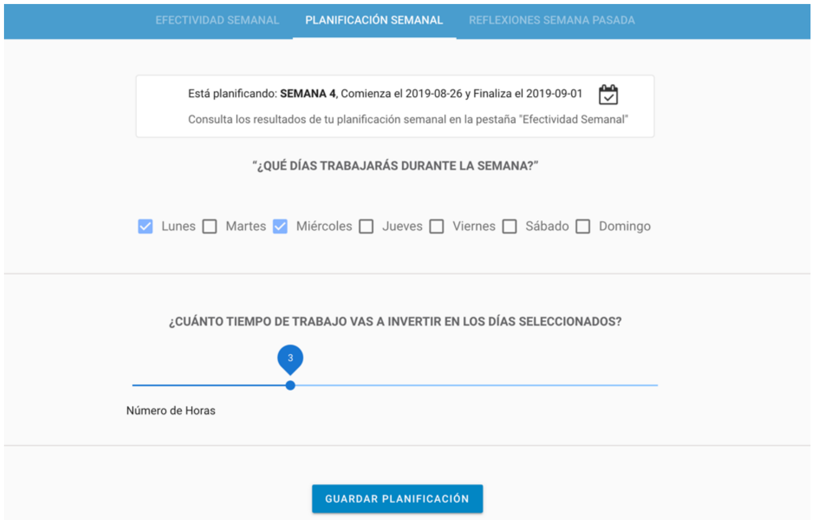


Figure 3-70. Form used by the student to plan the activities to be carried out this week.

• **Reflections last week (Figure 3-71),** allows the student to complete a form reflecting on their work during the previous week. In addition, it serves to self-assess the learning objectives acquired, as well as the benefit provided by the sessions of the classes with the teacher.

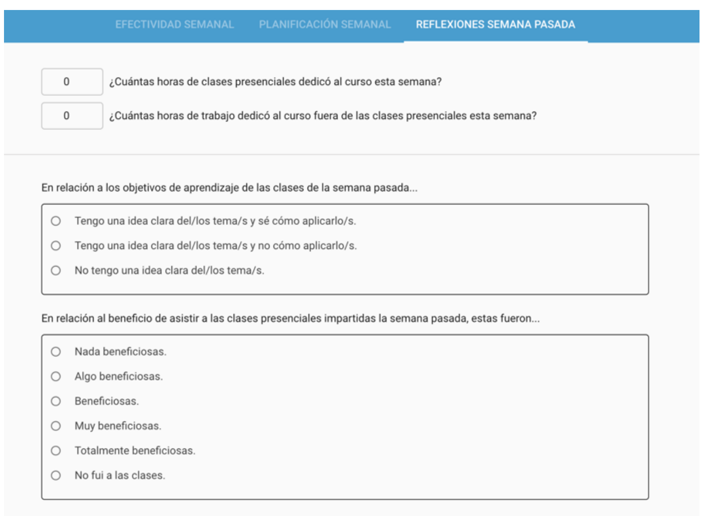


Figure 3-71. Meta-reflection form to assess the time spent during the work week, as well as the learning objectives achieved and the benefits of the classes with the teacher.

3.4. Adaptation of the Academic Dropout Early Warning Tool

3.4.1. Prediction Tool for MOOCS in PUC

This section describes the two versions of the algorithm developed to predict student dropout in MOOCs on the Coursera platform. These algorithms were developed for a set of MOOC courses deployed on the Coursera platform. Both differ from those used for academic prediction, since the study context is very different and the variables that can be used for prediction as well. On the one hand, it is not the same to complete an individual course (which has a fairly limited duration), than a university degree that can take several years. On the other hand, in the academic prediction the input data will be mainly academic data (from their grades), while in the course prediction the data will be taken from the interactions of the students with the course resources.

To implement the algorithms to predict dropout for MOOCs, data from 3 MOOCs (Massive Open Online Courses) deployed on the Coursera platform, which is the MOOC platform with which the Pontificia Universidad Católica de Chile works, was taken. These courses were: Electrons in Action, Constructivist Classroom and Management of Effective Organizations. All the courses have in common that they were taught in Spanish on the Coursera platform and that they were distributed asynchronously. In other words, students could enroll and take the course at any time. Specifically, two types of data were collected: (1) the trace files automatically generated by the Coursera platform and which record the activity of the students with the course resources; and (2) data collected from a questionnaire on the self-regulation profile of students that was completed voluntarily at the beginning of the course.

The first version of the predictive algorithm was carried out in 4 phases and served to prepare the data and identify the dependent variables related to dropout.

1. Data cleaning (student filtering). This phase consisted of eliminating the data that were not useful for the analysis. In the case of MOOCs, it is very common for the number of registered students to be very high (in the order of thousands of students). However, many of them do not even watch a video or do an exercise and are not useful for analysis. In this case, only the data of those students who had responded to the self-regulation questionnaire were taken. Below are the data considered for each of the 3 courses:

- Electrons in action - 2,035 students are considered out of the 25,706 enrolled since the first session of the course was launched in 2015.
- Constructivist Classroom - 337 students are considered out of the 18,653 enrolled since the first session of the course was launched in 2015.
- Management of Effective Organizations - 526 students are considered out of the 10,576 enrolled since the first session of the course was launched in 2015.

2. Obtaining higher-level variables (learning indicators). In order to obtain high-level indicators on the behavior of the students and to be able to use them a posteriori to implement the predictive model, a pre-processing of the trace data and the questionnaire was carried out. From these data, seven initial variables were defined

- **Variables on self-reported self-regulated learning strategies:** Obtained from the They provide information on aspects such as whether students are able to ask for help when they have difficulties, whether they know how to set their goals, whether they know how to plan their learning, whether they know how to assess themselves, etc. . These data are obtained from the initial questionnaire.
- **Self-regulated learning patterns:** They indicate the patterns that students perform when they access the platform. These patterns can be to enter to see only videos, only exercises, to enter to see the videos and at the end of doing the exercises, to enter and open the deliverable and then view the videos in search of the answers, etc. This data is obtained from Coursera events.
- **Demographic variables:** They include data such as the student's educational level, age, sex, and binary variables on whether the student is a student (in formal education) and whether or not they are working. These data are collected from the initial questionnaire.
- **Variables on intentions:** They collect information on the number of hours that the student intends to dedicate to the MOOC, and binary variables on whether the student is interested in the subject of the MOOC, if they have previous experience in MOOCs and if they intend to take the evaluable tests. These data are collected from the initial questionnaire.
- **Variables on the activity:** Indicators are included on the number of days active on the platform, the total time that the student has interacted on the platform and the number of different sessions in which they have worked. In addition, the type of interaction of the students with the videos and with the exercises is included, indicating if they begin, if they finish them or if they leave them unfinished. This data is collected from Coursera events.

3. Obtaining the variable to predict (in this case, the abandonment of the course). Once the learning indicators had been calculated for each student, the variable “dropout” was defined as the variable to be predicted. For this model, the variable “abandonment” was defined as inactivity for four consecutive weeks on the platform and that 80% of the evaluation activities had not been completed. Nor was it considered for the calculation of the variable “dropout” those students for whom little information was available because they joined the course one week before the date of data collection (December 25).

4. Development and evaluation of predictive models. The last step was to develop the predictive models. For this, the “Caret” library of free software R was used. This open source library implements several machine learning algorithms, which are used to carry out predictive models. In particular, several algorithms were tested with the indicators and the predictor variable of abandonment: (1) Random Forest (RF), (2) Generalized Linear Model (GLM), (3) Support Vector Machines, SVM) and (4) decision trees (DT).

To train the algorithms, the data collected with the information on the dropout or non-dropout of the course were used and the indicators established in point (2) were used as input. The output of these algorithms is a value between 0 and 1 that indicates the student's dropout probability. Values closer to 1 are higher probability values.

This first version of the algorithm was made with data from the course "Electrons in action". The objective was to understand which variables have a better relationship with the following dependent variables, related to dropout: (1) final grade for the course, (2) success defined as obtaining a grade higher than 80% without any restriction regarding seeing a number minimum number of videos and (3) success defined as obtaining a grade higher than 80% having seen at least 50% of the videos. To carry out this analysis, the five indicators defined in point (2) were taken into account as independent variables: (1) learning self-regulation strategies (SRL), (2) SRL patterns, (3) demographic variables, (4) variables on student intentions and (5) variables on student activity. In addition, three types of students were considered, identified by hierarchical grouping. The first group of students were the "sampling" students, who simply entered the course to "sample" some content and left. The second were the complete students, who followed the itinerary designed by the instructor and completed the videos and activities. The third group were strategic students, who were primarily focused on taking the assessment tests and watched fewer videos. Taking into account the variables and the groups, the prediction was made using regression models for each of the dependent variables and groups.

The results showed that the variables that had a greater relationship with the success or grade of the students were the SRL patterns and the variables related to the student's activity (in particular the time invested). Regarding the regression models for the prediction of the grade, the adjusted R2 for the different groups was 0.80 for the complete students, 0.72 for the strategic students and 0.86 for the set of all students (with p-value <0.001 in all cases). This indicates that the variables can explain a high variability in the model, although to a lesser extent for strategic students, who follow a less common itinerary. The RMSE (Root Mean Square Error) is between 0.12 and 0.18 for all groups, being worse for strategic students. Regarding the prediction of success, an excellent AUC (Area Under the Curve) (greater than 0.9) is achieved in all cases, except in the training set of complete students, which is obtained 0.84 (possibly because the number of samples is lower). However, it is observed that good prediction results can be obtained with SRL and activity variables, although other variables such as demographic or intentions have a worse relationship with the dependent variables.

Once the predictive model and the variables to be considered had been defined, the model was implemented in a web interface for the teachers of the Electrons in Action course. This web interface took the data that was generated week by week in the course, passed it through the model to predict the dropout level and displayed this result graphically, organizing the students into three groups (see Figure 3-72):

• Students with high dropout risk (probability> 66%)

• Students with medium dropout risk (probability> 33% and <66%)

• Students with low dropout risk (probability <33%)

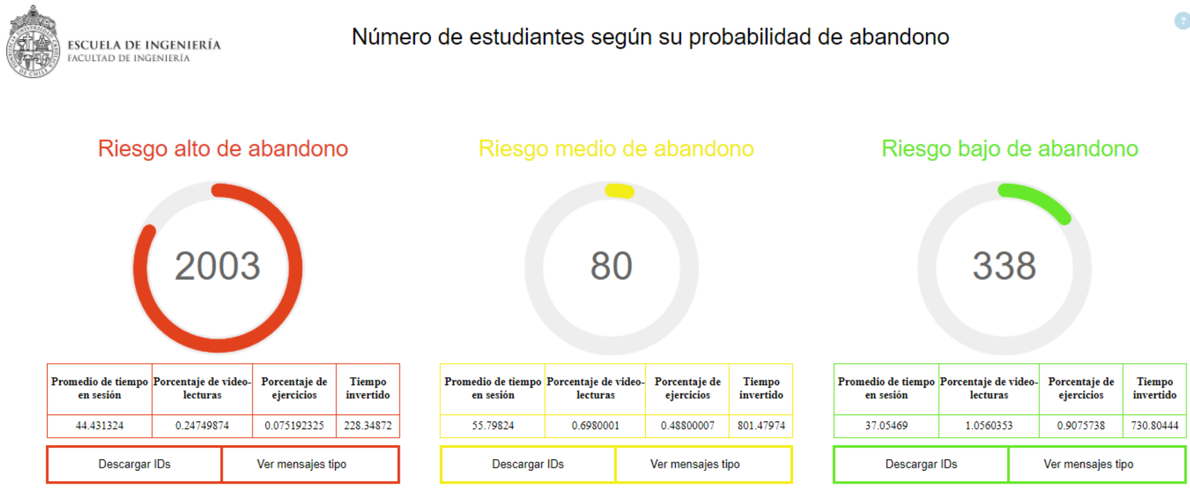


Figure 3-72. Web page interface developed to support Electrons in Action course teachers in detecting students at risk.

Each dropout group was represented by a red circle for students with high dropout risk, yellow for medium risk students, and green for students with low dropout risk. In addition, below each graph, significant data on the behavior of the average student in each group was added to help teachers better interpret the results of the predictive model. Using this data, the course teachers could send personalized messages to each group of students.

3.4.1.1 Version based on pilots and experience

After identifying the variables that were most related to the success of the students, a second version of the algorithm was carried out, extending the analysis to other courses. The objective was to check the variables that best predict student dropout in a MOOC and the most appropriate predictive model for the learning context.

For this second version of the algorithm, the analysis was extended to the other two courses: "Constructivist Classroom" and "Management of Effective Organizations". The dependent variable was the definition of "dropout" and the indicators defined in point (2) of section 4.1.1 were taken as independent variables. In this case, the predictive power of the different indicators was analyzed to identify the most significant ones. On the one hand, the predictive power of the SRL variables was analyzed and it was concluded that the self-reported SRL variables (obtained through an online questionnaire) do not add value to the predictive models. However, SRL patterns achieved high predictive power (with an AUC greater than 0.95), as well as interaction with videos and exercises. Therefore, it was concluded that the activity indicators with videos, exercises and the combination of these in SRL patterns are the most valuable for predicting dropout and are the ones that would finally be considered for the final predictive model.

In addition to analyzing the predictive power of the different indicators, the transfer of the models to the different MOOCs was also analyzed. That is, the possibility of using the models to different courses. The model finally chosen was Random Forest. Finally, a temporal analysis was carried out to see from what moment a high predictive power could be obtained in the models. The conclusion was that a good AUC could be obtained from between 25-33% of the theoretical duration of the MOOC (assuming one module per week and an excellent AUC between 43-67% of the theoretical duration of the MOOC. therefore, it also made it possible to obtain early predictions.

In conclusion, Random Forest was chosen as the predictive model and, as input variables, those shown in Table 3-11.

Variables related to demographics	
Edu	Educational level
Age	Age of the learner
Isfemale	Categorical variable representing whether the learner is male or female
Emp_student	Categorical variable representing whether the learner is a student (in formal education) or not
Emp_job	Categorical variable representing whether the learner has a job or not
Variables related to learners' activity	
Days_Act	Number of active days in the platform
Time_spent_min	Total time spent interacting in the platform (in minutes)
Num_ses	Number of sessions
Variables related to learners' interactions with videos	
Vl_complete	Number of times the learner has completed a video
Vl_begin	Number of times the learner has started watching a video without finishing it
Vl_review	Number of times the learner has reviewed a video once completed
Prop_vlopen	Percentage of opened videos (completed or not)
Prop_vlcomplete	Percentage of completed videos
Prop_vlreview	Percentage of reviewed videos
Variables related to learners' interactions with exercises	

A_try	Number of times the learner has started to do an assessment without finishing it
A_complete	Number of times the learner has completed an assessment
A_review	Number of times the learner has reviewed an assessment once previously completed successfully
Prop_atry	Percentage of attempted assessments (completed or not)
Prop_acomplete	Percentage of completed assessments
Prop_areview	Percentage of reviewed assessments

Table 3-11. Variables considered for the predictive model finally implemented

3.4.2. Academic Prediction Tool in degree courses

The second part of the dropout prediction was carried out in academic courses. In this prediction, an attempt will be made to calculate the percentage of probability of dropping out in the full career and in the first years of the career (bachelor) in different careers or networks of 3 universities such as: the University of Cuenca (Cuenca, Ecuador) , the Escuela Superior Politécnica del Litoral (Guayaquil, Ecuador) and the Austral University of Chile (Valdivia, Chile). Unlike the prediction in the MOOCs, to make this prediction more global data of the race and above all, academic data will be used.

The data taken for the prediction of the dropout in the careers, were taken from the academic results of the students, the socio-economic data of the students and the data obtained from the different careers or grids. The predictions are for each university, but the variables used are valid for calculating the probability of dropping out at any other university.

As explained in the prediction part for MOOCs, the steps to follow for the development of predictive models are the following:

1. Data cleansing (filtering students)

2. Obtaining higher-level variables (learning indicators)

3. Obtaining the variable to predict (in this case, dropout)

4. Development and evaluation of predictive models

These steps will be detailed below, since, for each university, different data and criteria were used to carry them out.

3.4.2.1 ESPOL

In the case of ESPOL, the data collected belongs to three different categories: demographic data of the student (marital status, employment status, place of birth, socio-economic factor ...), data on the different careers (number of total credits, semesters of each career, identifier ...) and data on the student's performance (state of the subject, time the subject has been taken, subject grades, subject credits…).

As we have mentioned previously, the data of those students that are not valid must be eliminated. That is, student data that is not correct or incomplete data. In the case of ESPOL, and although data began to be collected many years ago, these data were complete and valid to continue with the second step.

For the academic prediction, the most representative data of the evolution of the students in the career were chosen. These data were processed to achieve the highest level indicators. These indicators could be classified in the same categories mentioned above:

- Demographic indicators: These indicators show important data on the personal life of each student, such as work life, marital status or gender. In this case, it was not possible to use the socio-economic status of each student, since this data could not be collected from a large number of students.
- Student indicators: These indicators show data on the student's status in the career such as the percentage of credits approved, a weighting of the current average of the student in the career, the percentage of approved with respect to the total number of students presented.
- Indicators of each race: With the data of the students and the data of the different races a variable has been obtained that indicates the percentage of dropouts of each race.

When the indicators were obtained, the next step was to determine the dropout. To define the dropout variable and establish whether a student had dropped out, a maximum of years was used without the student enrolling. In the case of ESPOL, and after observing that a large number of students returned to their higher studies even after abandoning them after several years, it was decided to establish as a dropout the case in which a student has not enrolled in a subject for more than 5 years.

Finally, the last step was the development of predictive models. In the case of ESPOL, the Python programming language and free software from the Scikit-learn library were used. This open-source library implements many machine learning algorithms with which the different predictive models were carried out. Different tests were carried out with the following algorithms: Random Forest, Decission Tree, Support Vector Machine (SVM), Multi-Layer Perceptron (MLP) and Gradient Boosting.

With these algorithms, different tests were carried out for the training of the models from the data in which it had previously been defined if they had made a dropout or had finished the race. Thus, the predictive models that have as input the indicators and as an output, the probability of finishing each student's career were obtained. High probability values mean that the student has a high probability of graduating, while low values indicate a high probability of dropping out.

The visualization is part of the Statistics window, and displays a thermometer indicating how close or far the student is approaching a possible dropout, as well as the percentage (Figure 3-73). The indicators that are taken into consideration were explained in section 4.2.1. In addition, for the intervention and actions related to early prediction not only is this graph used, but it is combined with those already seen from the counseling tool.

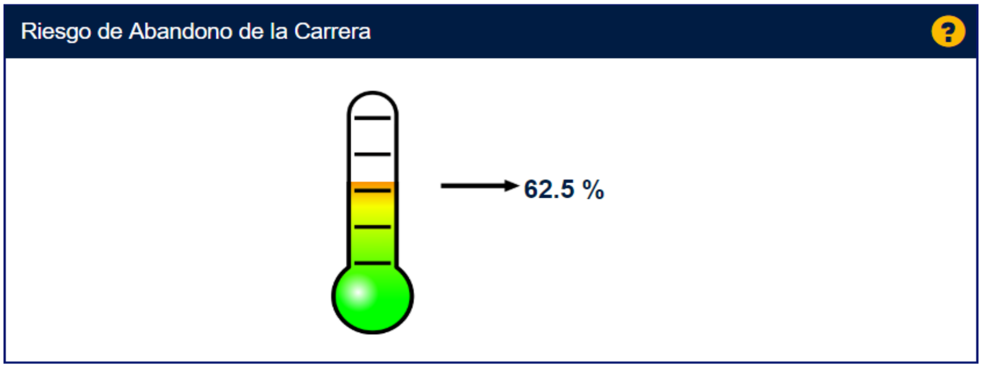


Figure 3-73. Career dropout risk window

3.4.2.1.1 Version based on pilots and experience

According to the predictive models tested in section 4.2.1.1 and since the dropout prediction is considered as a unique binary outcome characteristic, it was decided to improve the model using the Ramdom Forest algorithm, since this algorithm is known for its low tendency to over training and its high precision. For the tests of the improved model, it was decided to work with the data of one of the majors with the largest number of students, to later apply it to all the majors taught by ESPOL. On the other hand, based on the feedback received from the academic advisers and the academic authorities of ESPOL, there was a significant change in which they recommended changing the concept of academic dropout for academic retention, with which academic retention equal one is for those students who continued the career and graduated; and equal to zero for students who did not enroll in any course after five years from their last enrollment.

The predictive model goes through an improved pre-processing, which consists of: recognition of the ordinary academic terms of the students and the enumeration of the semesters in which the students have been studying with their respective academic history; in order to run the analysis by semester. After pre-processing, the process begins with assigning retention equal to one or zero, according to the definition of academic retention stated above. Consequently, the semester selection was carried out cumulatively; that is, select the academic history of all students in their first semester and enter these data into the model; then, selecting the students in their first and second semesters and entering this data into the model; and so on, until the fifth semester, which represents two and a half years of study. After the fifth semester, all students who had more than five semesters in their careers were assessed. Each semester group was used to calculate the academic performance indicators and consequently define the data set that was taken for training and testing.

Regarding the indicators used for the model, after pre-processing, new academic performance variables were calculated, which are detailed in table 3-12. We apply a correlation matrix to analyze how the different variables were affected within the proposed model. Therefore, demographic indicators were discarded, because these variables had a correlation coefficient less than 0.1.

Identification	Description
V1	Average number of subjects taken per semester during the years of study.
V2	Number of times a subject is taken a second time
V3	Number of times a subject is taken for the third time
V4	Period in years that the student takes to return to study a following semester
V5	Average marks of all subjects with status Approved, Failed, Accredited and Validated
V6	Average of marks of the subjects in which the student registers with status of Approved and Failed
V7	Average marks of the subjects for the number of credits greater than zero, for the penalty of the number of times the student takes the subjects
V8	Average of the subjects approved by the student
V9	Average of the subjects failed by the student
V10	Average of the subjects canceled by the student

Table 3-12. Variables used in the predictive model

Additionally, we use other methods to identify and select the variables with the greatest influence; therefore, each career and semester is predicted with the most critical entries. In addition, we apply the percentile calculation to place students in their respective retention levels (very low, low, medium, high, very high). We use the Shap library to interpret the model and understand how the individual parameters influence the prediction of the model, and with the shap values we generate the percentage of influence of the variables in the prediction that are used for the display panel.

The precision results when the model was applied to our test run was more than 95%. Therefore, it was decided to scale the model to all the races dictated in ESPOL. The selected data from 2000 to the first semester of 2019 has a total of 29,983 students. Due to the time of the selected data, there were some changes in the naming codes of the races. However, the essential structures of the races were preserved. With the purpose of scalability, a process of unifying the racing codes was carried out to avoid the loss of information. A total of 65 races were predicted, obtaining favorable results and an average accuracy greater than 80%.

Based on the feedback received from the academic advisors and the academic authorities of ESPOL, some improvements were made to the display of this module. The panel changed position, being located on the main page of the advisory system (Figure 3-74).

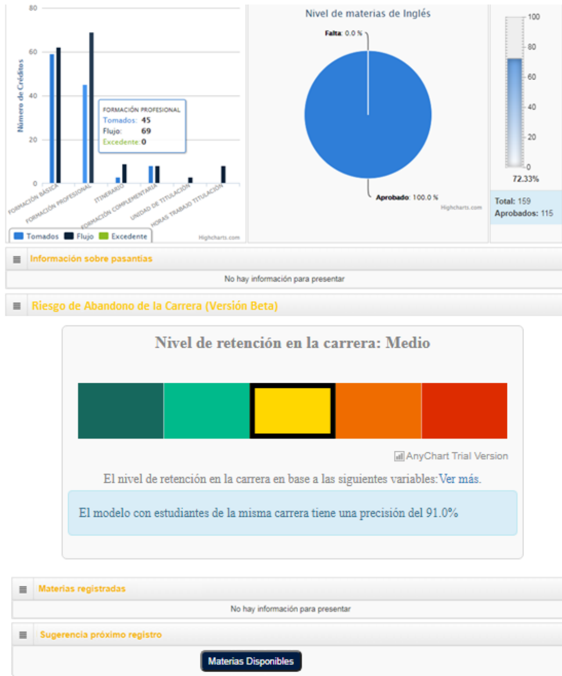


Figure 3-74. Academic retention panel embedded in the counseling system

As can be seen in Figure 3-74, the panel shows different levels, based on a color scale: dark green (very high), green (high), yellow (moderate), orange (low) and red (very low) that indicates the level of academic retention provided by the predictive model. The accuracy of the prediction is also displayed. Additionally, assessors can learn more by clicking the link at the bottom of the retention level scale that allows them to view the variables that influence the prediction.

Once the advisors click on the link, a pop-up window like Figure 3-75 appears, showing the essential variables information and the level of influence. At the top, a question is displayed to see if the academic advisors consider the information displayed to be consistent. When hovering the mouse over each variable, an explanation is displayed in the lower right corner about the effect of this variable.

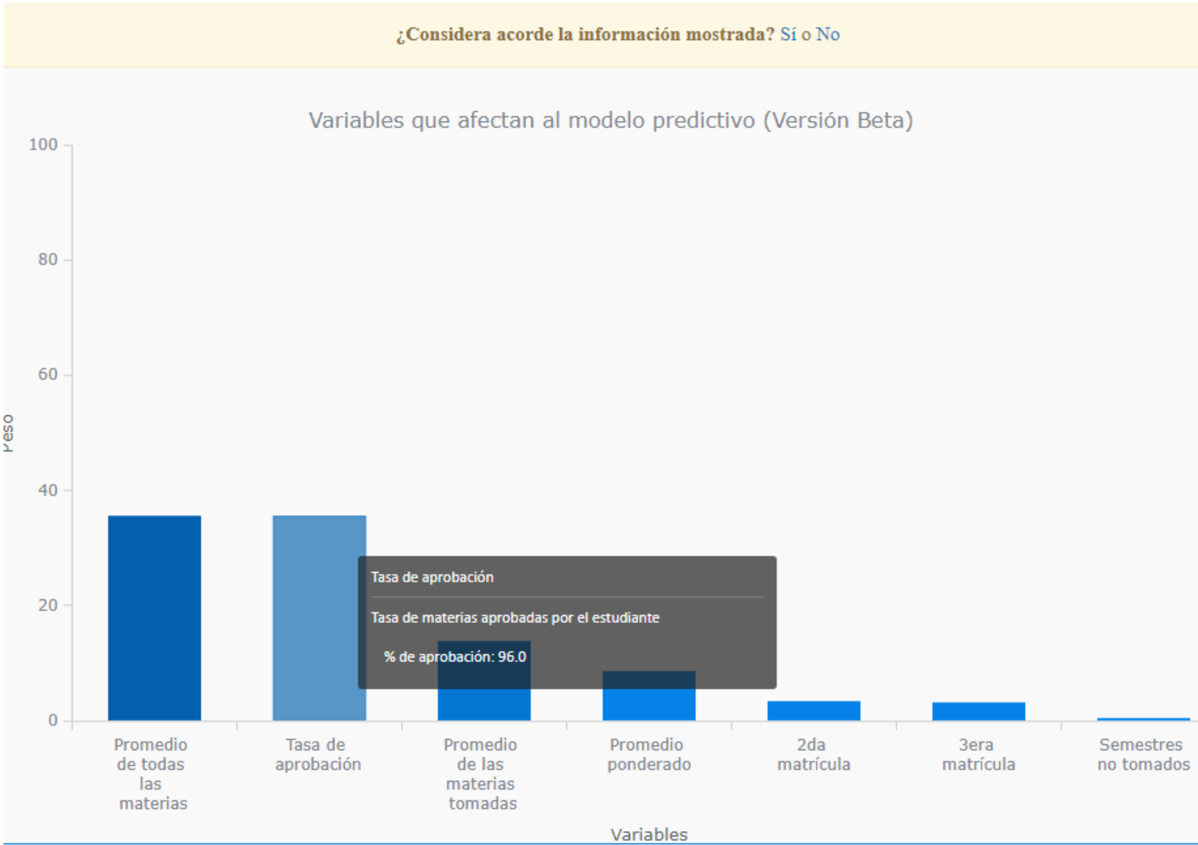


Figure 3-75. Impact of the variables that affect the predictive model and explanation tooltip

3.4.2.2 UACh

The next scenario for the development of the prediction models is that of the Austral University of Chile (UACH). In this case, only academic data is available, that is, the results of each student are available in all enrolled subjects, whether they are taken, validated, canceled, etc. The data collection period is from 2011 onwards. This collection period is one of the first conditions for filtering data. As there were students who had started their studies before 2011, they have been discarded since their trajectory could not be established from the beginning. On the other hand, those students who have recently enrolled have also been filtered because, while they are studying the degree, there is still no information on whether or not they finished the degree. From these academic data, five indicators have been obtained for prediction:indicators have been obtained for prediction:

- **Average grade:** Average grade of the enrolled subjects
- **Ratio taken:** Ratio of the subjects taken to the total number of subjects enrolled. A course may not be taken if it is validated, recognized, canceled or due to a change of plan.
- **Canceled ratio:** Relationship between canceled subjects and enrolled subjects.

- Repetition ratio: Indicates the relationship between the number of subjects of a student and the total number of calls for the subjects. For example, if a student has 5 subjects and one of them is repeating it (he is in 2nd call), the ratio will be 5/6.
- **Approved ratio:** Indicates the relationship between approved subjects and enrolled subjects.

The previous variables can be obtained either globally taking into account all the data or by semesters, in such a way that, if a student has been in three semesters, there will be 15 variables (the set of five variables for each semester), which It can provide more information on the evolution of the student.

Once the indicators have been obtained, the next step is to determine the variables to predict. In this case, unlike ESPOL and U. Cuenca, two variables will be taken. One of them will be dropout, which is defined as not enrolling in any course for two consecutive semesters (equivalent to an academic year). Unlike the previous cases of Ecuador, in Chile it does not seem that it is so frequent that a student returns to the race long enough later, so the time of non-enrollment to consider dropping out is shorter.

On the other hand, a fairly frequent problem at UACH is that students take a long time to finish the first two years of their degrees (what is known as the "Baccalaureate"). It is possible to find students who are quite advanced in their career, but with still pending subjects from the Baccalaureate. Therefore, it is proposed to predict a second variable, which is the time it will take for students to finish high school.

Finally, once the predictor variables were defined and to be predicted, the predictive models were developed. In this case, the R caret library was used, which is open source. From this library, the following algorithms were used: (1) Random Forest (RF), (2) Generalized Linear Model (GLM), (3) support vector machines (SVM), (4) decision trees (DT), and (5) neural networks (NN). The output of these algorithms was the dropout probability (between 0 and 1) in the case of the dropout and a number, representing the number of semesters it will take the student to complete the Baccalaureate.

The information stored in the database regarding prediction was described in the backend section, specifically in the detail of the table "student_droput"

To design the prediction tool, the interviews carried out at the beginning of the LALA project with the institutional leaders were analyzed and a simple proposal was developed but that helps the most frequently mentioned problem in the Faculty of Engineering, the high dropout rate of the students during the engineering baccalaureate and the long time it takes to complete high school courses. In the upper right part of Figure 3-76 you can see the predictions made.

Figure 3-76. Module of progress and prediction of semesters to finish

- This module will only be visible to program directors who direct careers that include a baccalaureate plan (you must define whether it is active or not for each one, in the configuration)
- Shows the percentage of progress with approved subjects / total subjects of the first two years that corresponds to the baccalaureate cycle, for the engineering programs.
- All the information will come in the GetStudentAcademics service (described in the Backend of the Counseling tool). The new attributes are:
  - "bachCompletedCourses": number,
  - "bachTotalCourses": number,
  - "estimatedTermsToCompleteBach": number,
  - "estimatedProbability": number

3.4.2.2.1 Version based on pilots and experience

The experience of the piloting allowed to implement improvements to the original design. The most relevant improvements are detailed below:

The drop-out risk display was complemented with a new functionality that allows listing all the students in a program with their risk indicators. This list, shown in Figures 3-77 and 3-78, allows finding students at risk from among the enrolled students. The risk is expressed as a risk percentile and is accompanied by a text such as "the student is within the 27% lowest risk". The list of students allows you to sort by year of start in the program, level of progress and risk of dropping out (see Figure 3-79).

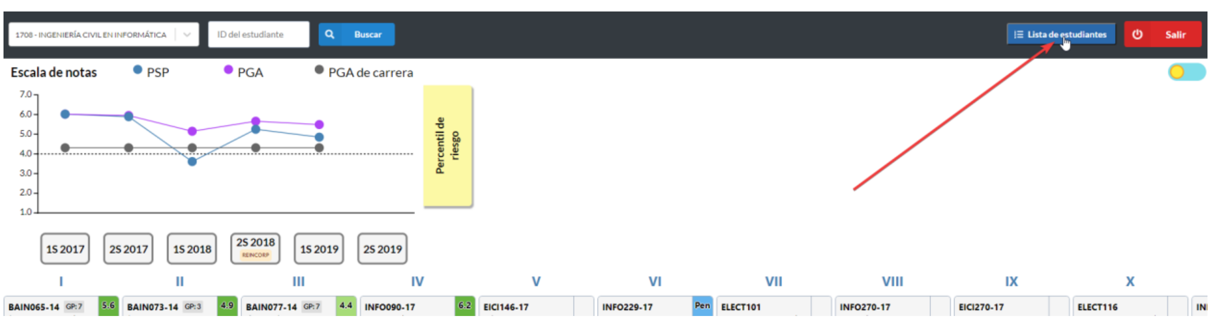


Figure 3-77. Student list button.

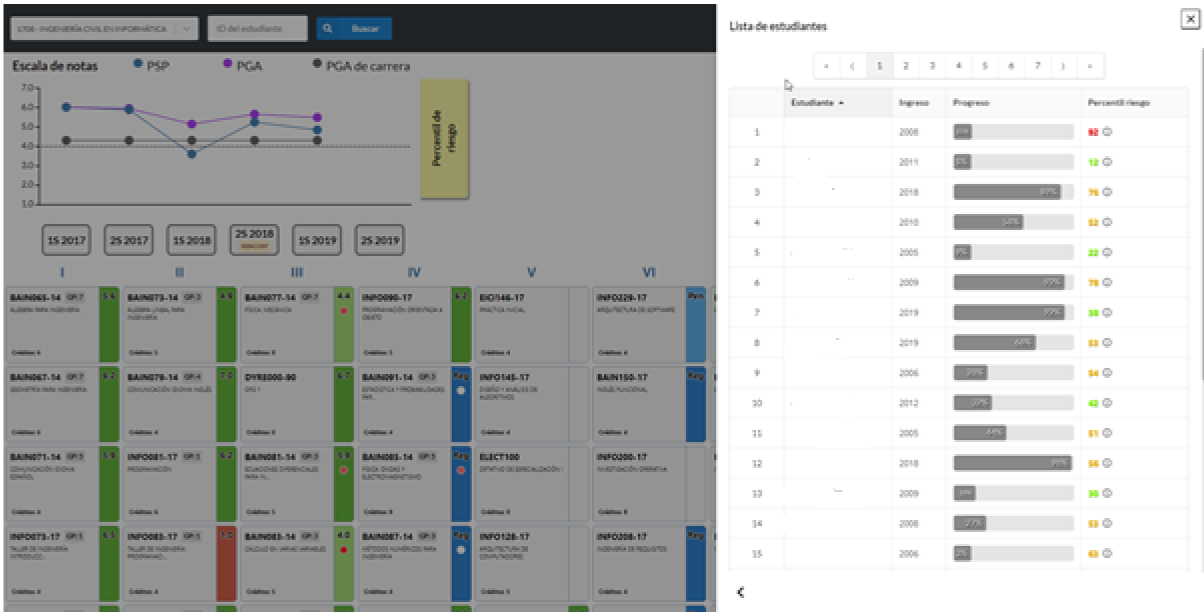


Figure 3-78. List of students in the form of a “Drawer”.

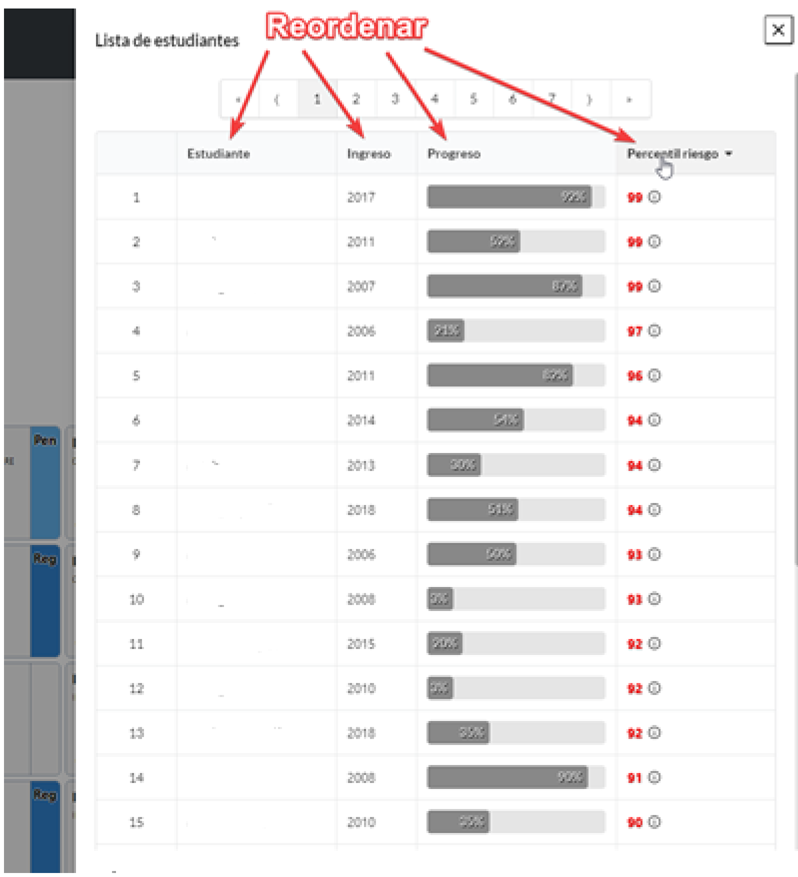


Figure 3-79. Reordering the list.

3.4.2.3 UCuenca

In the case of UCuenca, the data collected belongs to 3 different categories: demographic data of the student (type of school the student attended, socio-economic factor ...), data on the different majors or grids (number of total credits, semesters of each career, identifier ...) and data on the student's performance (student status, subject status, registration number, subject grades, subject credits…).

The data provided by UCuenca had to be cleaned, since the data of some students was incomplete. At the time of collecting the data, some students had already started their degree and since data from previous years was not collected, much of the data was not complete. Once the data provided was cleaned, the highest level indicators began to be calculated with the most representative data of the students and the meshes. These indicators could be classified into the following categories:

- Demographic indicators: In the case of UCuenca, only the socio-economic factor was used since no more personal data was obtained from the students.
- Student indicators: These indicators show data on the student's status in the career, such as the percentage of credits approved, a weighting of the current average of the student in the career, the percentage of approved with respect to the total number of students presented.
- Indicators of each race: With the data of the students and the data of the different races a variable has been obtained that indicates the percentage of dropouts of each race. In addition to the ratio between the number of semesters enrolled and the semesters that each course has.

Once the indicators were obtained, the next step was to determine the output variable (dropout). To define the dropout and establish whether a student had dropped out, a maximum of years were used without the student enrolling. In the case of UCuenca, it was decided to establish as a dropout the case in which a student has not enrolled in a subject for more than 3 years.

Finally, the last step was the development of predictive models. In the case of UCuenca, the Python programming language and free software from the Scikit-learn library were used. This open-source library implements many machine learning algorithms with which we proceeded to make the different predictive models. Different tests were carried out with the following algorithms: Random Forest, Decission Tree, Support Vector Machine (SVM), Multi-Layer Perceptron (MLP) and Gradient Boosting.

Using these algorithms, different tests were carried out for the training of the models from the data in which it had previously been defined if they had dropped out or graduated. In this way, the predictive models that have as input the aforementioned indicators and as output, the probability of finishing the degree of each student were obtained. High probability values mean that the student has a high probability of graduating, while low values indicate a high probability of dropping out.

The early dropout prediction system was considered as part of a visualization of the counseling system and not as a separate system. As a consequence, both tools were worked together, having the same methodology explained in the counseling section. The visualization is part of the student's statistical information window, and shows a visualization ("Career Dropout Risk") indicating how close or far the student is approaching a possible dropout. The indicators that are taken into consideration were explained in the previous section. In addition, for the intervention and actions related to early prediction, this graph is not only used (Figure 3-80) but it is also combined with those already seen from the counseling tool.

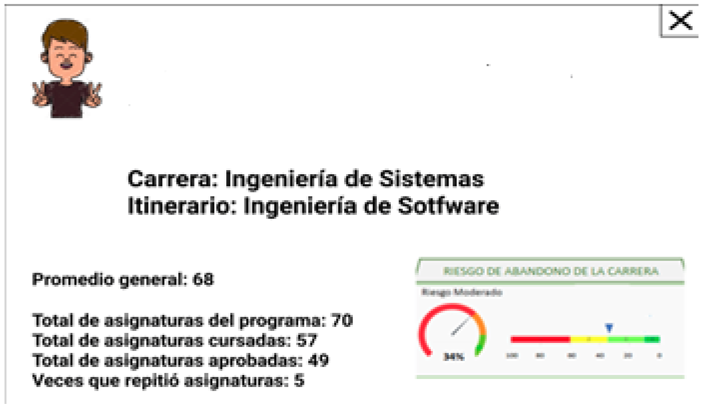


Figure 3-80. PopUp Statistical information of the student

3.4.2.3.1 Version based on pilots and experience

In accordance with the pilots carried out and the feedback received from the academic advisors on the student dropout prediction tool, it was decided to continue using the Ramdom Forest algorithm, which stands out for its high precision and ease of use. the training. In addition, the most important academic data were used as input variables to increase the precision of the algorithm. As one of the most important changes for the operation of the algorithm and prediction tool in general, it was decided to show the probability of academic retention instead of the probability of academic dropout, where the value of one or, greater than or equal to 0.5 means that the students finished their degree or have a high possibility of graduating, while the value of 0 or less than 0.5 means that the students did not finish the degree or have a possibility of not graduating.

The predictive model applied, as a first step, separates the academic performance of the students by semesters, this is done through the enumeration of semesters in which the student has been studying with their respective academic history, that is, for the third semester you have the history of the first, second and third semester, for the fourth semester, you have the history of the first, second, third and fourth semester, and so on. Then, the prediction is made with the data indicated above, for this, the academic records of the students are considered cumulatively by semester, that is, to calculate the probability of a second semester student's degree, the academic records are used of all the students in that career who are taking or have already taken up to the second semester, if the student is taking the third semester, all academic records up to the third semester are considered, including the academic record from the second semester. With this, the results indicated by the algorithm will be in the range from one to zero, which was explained previously. In addition, it was considered that the students who have completed the degree are all those who have already passed more than 80% of subjects, this, because the data of the students who have graduated are not available.

When the enumeration of the semesters is carried out at the beginning of the model, certain variables are also calculated that will serve as input variables for the algorithm, these variables are the following (Table 3-13):

Entry	Description
E1	Average number of subjects taken per semester during the years of study, does not include subjects canceled or withdrawn.
E2	Number of times a subject is taken a second time.
E3	Number of times a subject is taken for the third time.
E4	Period in years that the student takes to return to study a following semester, usually two years.
E5	Average of marks of all the subjects with Approved, Failed, Approved and Validated status.
E6	Average number of subjects passed by the student.
E7	Average number of subjects failed by the student.
E8	Average number of subjects canceled by the student.
E9	Student approval form in each of the subjects (Homologation, Validation, Schooling, Extraordinary Exam).
E10	Number of hours of the subject.
E11	Total hours of study that the degree contains.
E12	Name of the Career and Faculty.

Table 3-13. Variables used in the predictive model

Finally, only 5 faculties were considered to make the prediction, this, in order to adjust the algorithm for all the faculties in the future. Each faculty has a different way of working and qualifying, therefore, the name of the major and faculty was considered as an important input variable, thus, the results shown by the algorithm will be much more accurate for each faculty and career.

Based on the pilots on the prediction tool, despite the fact that its use has been minimal by users, and, through a fairly broad analysis, with feedback from experts on the subject, it has allowed to implement improvements to the original design. These improvements are changes both in the visualization, as well as in the form of the prediction. The most relevant improvements are detailed below:

Perhaps the greatest improvement of the prediction tool is not presenting the risk of student dropout, but rather, the probability of remaining in the career. This causes big changes when it is presented in the visualization. Consequently, the prediction is presented in a dialog or popup in the shape of a thermometer where the level of this indicates the rate of permanence of the student in the career, as shown in Figure 3-81. In addition, circles are presented around the thermometer, which contain the names and values of the most important variables when making the prediction; A tooltip is also presented for each of the variables (Figure 3-82), to provide detailed information to the user about the importance of the variable with a comparison of the average number of students who dropped out, thus allowing the user can provide more accurate advice to the student. Also, in order for users to provide feedback on the prediction they see for each student in different careers, a question is displayed at the bottom of the thermometer indicating to the user whether or not they agree with the prediction.

Finally, and to solve the problem of little use of the visualization tool, the access place to it was changed, placing it in the main view, as shown in Figure 3-83.

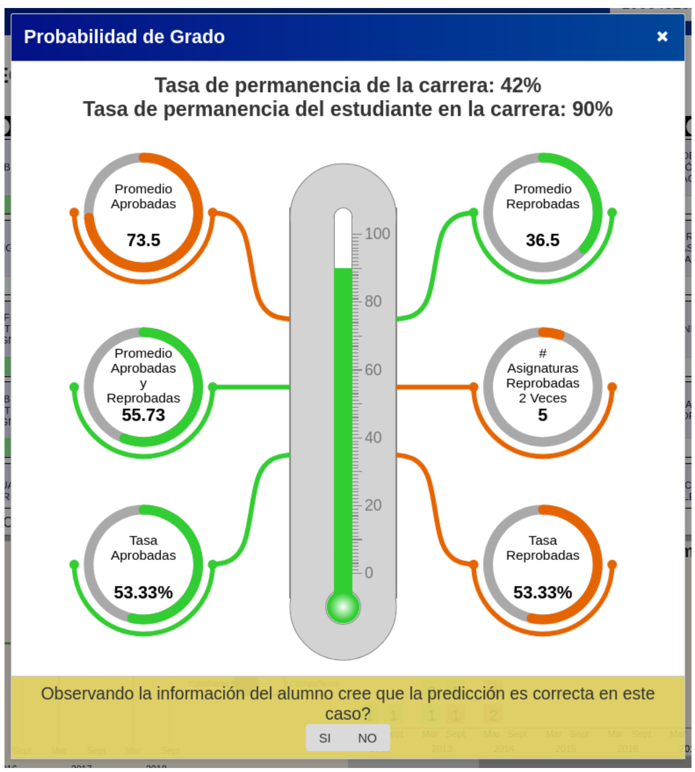


Figure 3-81. Dialogue Rate of permanence of the student in the career.

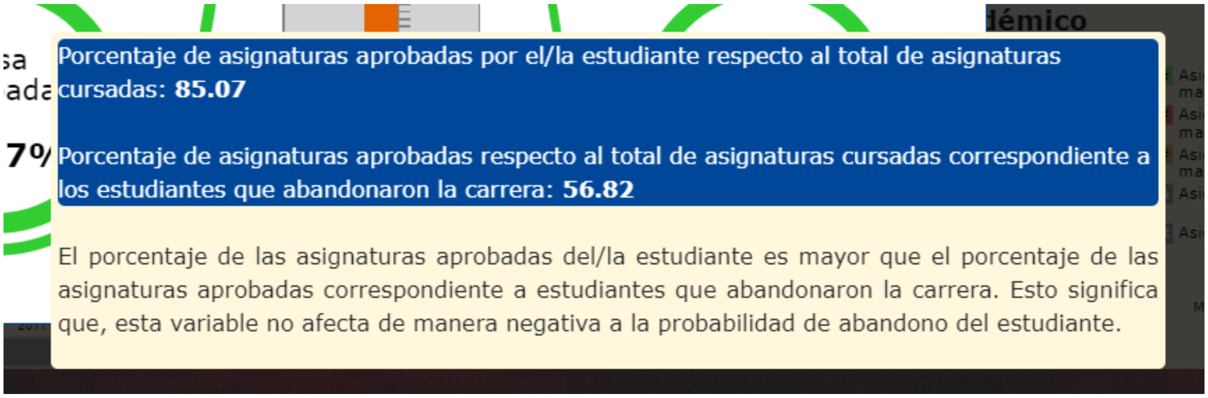


Figure 3-82. Detail of the variable in the prediction.

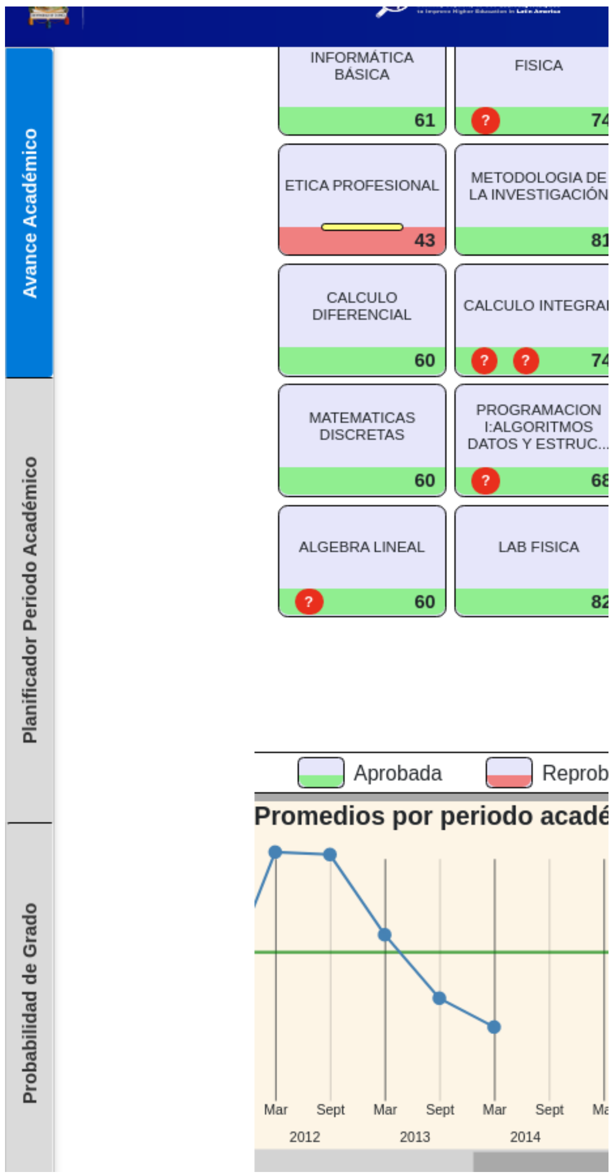


Figure 3-83. Access option to the Permanence Rate Dialog.

3.5. Ontask

OnTask is a tool that assists teaching staff to provide timely, personalized and actionable student feedback throughout their participation in a course in order to improve their academic experience. By providing frequent suggestions about specific tasks in the course, students will be able to quickly adjust their learning progressively. Figure 3-84 shows the flow of the data through OnTask. It receives data from different institutions' source files, like LMS or demographics, and generates a table with the attributes per student. These attributes can be used by the instructor to provide personalized feedback (action-out), and eventually, the students answer questions that are included on the initial table (action-in).

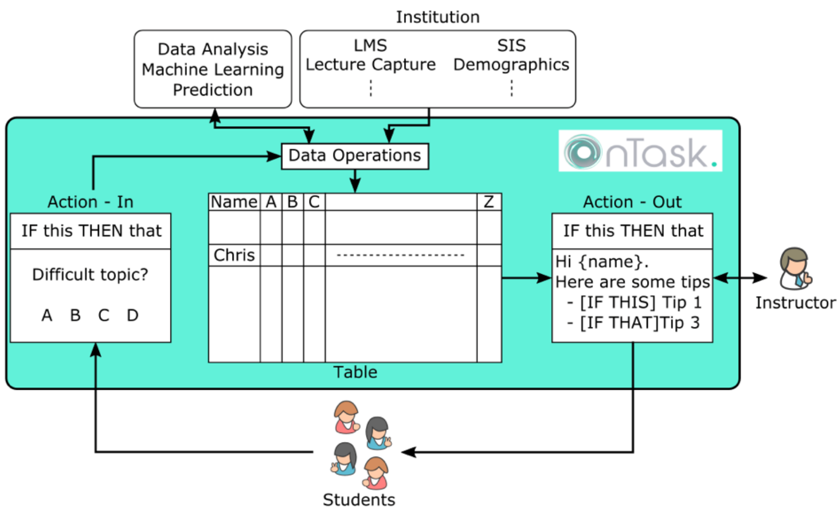


Figure 3-84 Flow of activities

The instructors can write personalized feedback through an interface that provides resources to create a set of 'if…then' rules. Figure 3-83 shows the interface to create a personalized email; it encapsulates general text, generic attributes like {{GivenName}} and the rules. The most significant benefit is to create messages to a large cohort of students without needed to write similar messages repetitively. In order to adapt the tool, the universities in Latin America have to define which attributes would be used based on their LMS or SIS system. It means that the teacher will use the same user interface as shown in the figure below; however, the technical team should provide a service to integrate the data with OnTask to allow the use of it. This adaptation could be made by integrating the institution database with OnTask directly or by importing a CSV file into the system before use it.

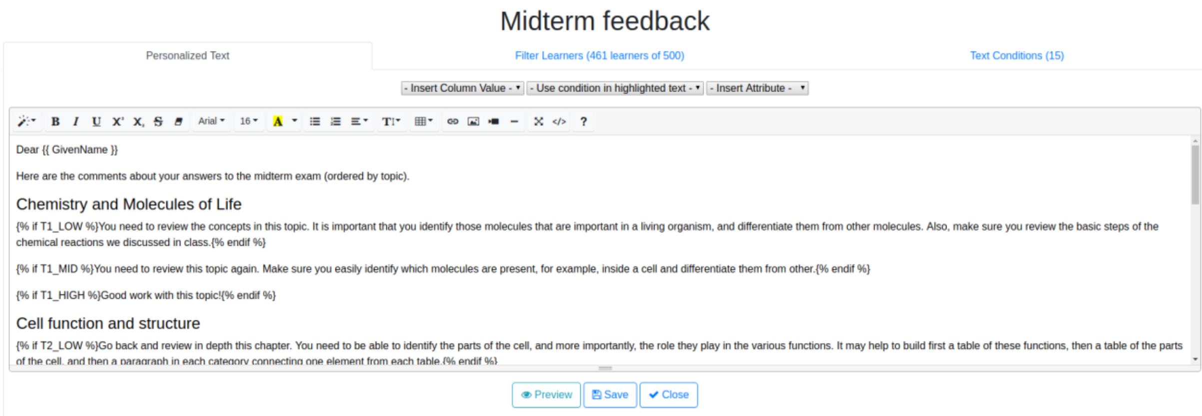


Figure 3-83 Interface for creating personalized emails

It is important to mention that OnTask is an opensource tool, highly documented (https://github.com/abelardopardo/ontask_b) and we are using the Django version. Besides, the tool is LMS agnostic and receives its data from various sources such as video engagement, assessments, student information systems, electronic textbooks, discussion forums, etc. In order to set up the server to run OnTask, the partner should follow the step-bystep detailed on this link: https://abelardopardo.github.io/ontask_b/Install/index.html. As requirements, the server should have Python 2.7 and Python 3.6, Django 2.1.4, Redis, PostgreSQL (version 9.5 or later). The tool was developed using python based on Django and Pandas. Besides, it uses ORM and SQLAlchemy and a database decided by the institution that will adopt OnTask. Thus, in order to adopt it, the higher education institution needs to define which data source would be used as input, instantiate a database and a server (available here: https://github.com/abelardopardo/ontask_b), and finally integrate the uses to provide login accounts (Figure 3-84).

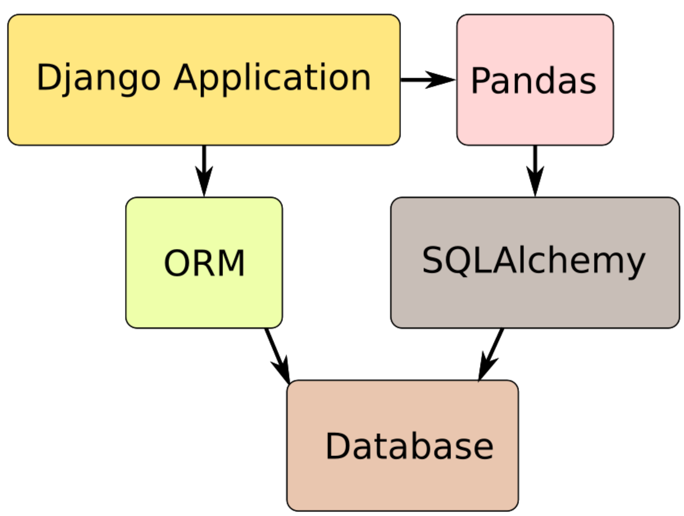


Figure 3-84; Backend technologies

As part of LALA project, the University of Edinburgh is assisting the partners to adopt Ontask to their context. It involves both technical and pedagogical support. The technical support includes activities related to the instantiation of the tools (https://abelardopardo.github.io/ontask_b/Install/index.html) on the servers bought during the project, synchronization with the university data source (e.g., LMS) and the training for teaching staff that will use it. On the pedagogical side, the team from the University of Edinburgh will assist the partners on the initial adoption by providing training on how to create the emails using the tools and what are the pedagogical issues that could happen during the use of OnTask.

Finally, the development process of the tool can be seen in https://www.ontasklearning.org/scenarios/ and https://abelardopardo.github.io/ontask_b/Introduction/index.html. Our focus on this document was on the adaptation of the tool to the Latin American partners..

3.6. iCora

The experience of the pilots also motivated the development of iCoRA. A web tool that helps students decide which subjects to register for in their next semester. The tool allows you to compose course sets interactively and, in response to these interactions, provides personalized performance predictions, taking into account the student's academic history and the historical performance of others. It is currently in the design phase at ESPOL.

To help students make better and more informed decisions about their enrollment options, iCoRA also provides access to historical statistics for the subjects in a curriculum grid (e.g., pass rate, grade histogram, indicators of difficulty) and information on the academic load that students would face given a particular course selection.

The main goal of iCoRA is to streamline the academic counseling process. In particular, students are expected to use the tool prior to the counseling session where they discuss their registration alternatives with their counselors.

Our long-term goal includes assisting counselors as well, to inform them of the registration decisions and intentions that students make when using iCoRA. However, the current version of the tool focuses on students, as described in the following sections.

Graphic interface

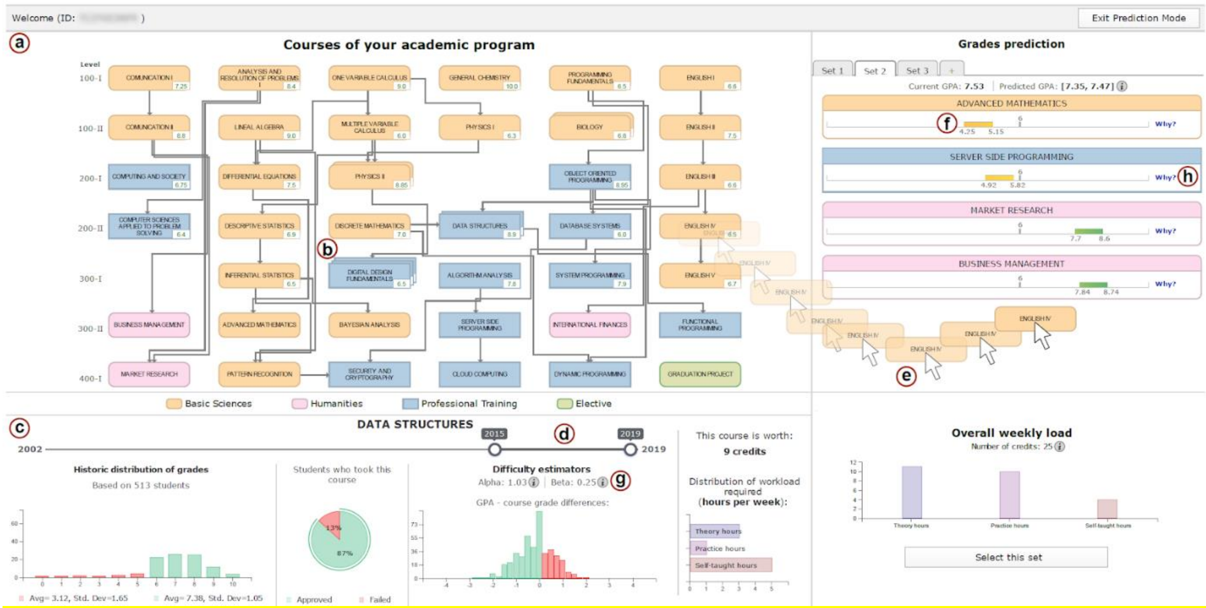


Figure 3-84. iCoRA Graphical Interface

The entry point of the tool shows the student's academic program as a mesh of courses and connections that indicate the pre-requisites and co-requisites (Fig.3- 84a). The subjects are organized into four categories (basic sciences, humanities, professional training, and electives), according to the internal organization of ESPOL. Each of these categories is coded with a different color.

The view of the academic program shows, within each subject, the grade obtained by the student. Grades are displayed in green for approved courses and in red for failed courses. Courses that have been taken more than once appear as groups of overlapping rectangles, each of which represents a record instance (eg, Fig. 3-84b).

The historical information of the subjects is displayed by clicking on the elements of the academic program. This information includes general and historical information (Fig. 84 c): number of credits, weekly workload, difficulty estimators, grade distribution, and historical performance. These data can be filtered by time through an interactive range (Fig. 84 d) that helps to explore the evolution of the course over time and allows obtaining information on the performance of students who have registered in recent editions of a given course. This is relevant to support students in making decisions based on recent data.

Performance Predictions

In prediction mode, the subjects available in the academic syllabus can be dragged to the grade prediction panel (Fig. 84 e) to compose one or more subject sets. These interactions trigger the iCoRA performance prediction models and update the graphical interface. The prediction models for each subject are based on Gradient Boosting Trees (GBT) trained with historical data including: semester load, previous grades, failure history, and aggregate difficulty of subjects.

The performance prediction for each course is shown as a horizontal range (calculated using quantile regressions of the GBT output). The range illustrates a scale between 0 and 10, in accordance with the ESPOL rating system. This representation of range seeks to communicate to students that the predictions provided by the tool are estimates and, therefore, carry some uncertainty.

When designing our tool, we decided against displaying an exact score as the output of the prediction models. The consensus was that an exact value could confuse students and skew their expectations, which would be counterproductive to the objectives that our tool pursues. The range is shown through a red-yellow-green divergent color scale with a value of zero centered on 6, which is the minimum grade to pass a subject in ESPOL.

Explanations

iCoRA provides explanations for some of the input characteristics used in its prediction models. These explanations combine text, visualizations, and mathematical formulas. For example, the difficulty estimators used in the tool are explained (Fig. 84 g). Likewise, the predicted performance for each subject is explained by the Why? Button displayed to the right of each range (Fig. 84h). This button displays a pie chart whose pie sectors are colored to indicate the positive or negative influence of the input characteristics on the predicted result.

iCoRA provides these explanations to motivate students to capitalize on the factors that could positively influence their performance. Perhaps more importantly, these explanations seek to persuade students to address sources of negative impact on their performance. For example, one way to reduce the risk of getting a poor grade in specific courses would be to decrease the semester academic load, which could be accomplished by enrolling in fewer courses or registering in less challenging subjects.

Evaluations

We are currently evaluating an early prototype of iCoRA with the goal of informing future iterations of the tool. Our initial evaluation focuses on knowing the perspectives and impressions of the students and the usefulness they perceive. The results and observations of this evaluation are in the analysis stage.

Future evaluations will focus on the effectiveness of the tool and the influence it could have on the decisions that students make when deciding which subjects to enroll in.

3.7. Conclusions

This chapter presented the changes in both backend and frontend that derived from the experience of piloting the counseling tools, self-regulation skills, and early dropout, of the different Latin American universities, partners of the project.

The feedback received from the target groups who used the tools guided the universities to make changes to the visualization panels, by adding or removing functionalities. On the other hand, in very specific aspects, complete changes had to be made to the backend. For example, in the case of UAch, this change was due to the fact that the data was received in "raw" and a lot of time was invested in preprocessing. Likewise, the piloting experience contributed to the design of new versions of the tools, as was the case with Icora.

The importance of continuing to make changes even when a learning analytics tool has gone through a design process is reiterated. It is precisely the piloting phase, which provides the necessary information to be able to make decisions and make the respective changes for the benefit of users.

It is hoped that this experience will help other HEIs to do something similar. In this way, the process of adopting learning analytics tools to HEIs in Latin America is facilitated.

References

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4.- Final Pilot Experiences

This chapter describes the final pilot experiences done in 8 different HEIs in Latin American in the context of the LALA project.

To develop the above-mentioned local capacities, different activities have been defined, each of which results in a product. The purpose of this document is to give details about real use of LA tools by HEI. To this end, it presents a compilation of the experiences of pilot projects in the different Latin American universities that make up the LALA partnership (Universidad Austral de Chile, Pontificia Universidad Católica de Chile, Escuela Superior del Litoral and Universidad de Cuenca).

Prior to the execution of the pilots, each of the participating Latin American universities detected their needs using the recommendations of the LALA Framework (deliverable prior to project) and adapted or adopted LA tools (deliverable prior to project). In particular, these adaptations were inspired by the counselling tools using visualization dashboards designed at KU Leuven, and the tools for the early detection of dropout developed at Universidad Carlos III de Madrid (UC3M). Likewise, the University of Edinburgh gave advice and support in the use of the OnTask tool to interested Latin American universities. Details of these prior activities are available on the project website (https://www.lalaproject.org/deliverables/).

As a result of these prior activities, the existing tools and services were adapted/adopted, resulting in four sets of tools, each one adapted to the four Latin American partners. They all include academic counselling tools and dropout prediction tools. The toolkit has different names according to each Latin American partner; these are: TrAC (Trayectoria Académica y Curricular) at Universidad Austral de Chile (UACh), NoteMyProgress and DaP-MOOC at Pontificia Universidad Católica de Chile (PUC-Chile) and AvAc (Avance Académico) at Universidad de Cuenca (UCuenca). In the specific case of the Escuela Superior del Litoral (ESPOL), since it already had an institutional tool, the counselling and prediction tools were embedded into its previously existing counselling system called SiCa (Sistema de Consejerías Académicas).

The pilots were coordinated by UACh with the support of UC3M and have participated all the partners of the LALA project and four universities extra to the consortium, Universidad de Chile (UChile), Universidad Politécnica Salesiana (UPS), Universidad Federal Rural de Pernambuco (UFRPE) and Instituto Tecnológico de Zitácuaro. The execution of the pilots was carried out from 2019 to 2020. This report includes experiences updated to October 2020 in which real users were involved in real use contexts. To this end, five phases were followed: preparation, agreement, training, use and improvement. Each of these phases is detailed in the following section. More information related to the tools is available in Figure 4-1.

We hope that the information presented in this document can help other HEI move towards effective adoption of their LA initiatives.

UACh	
Trac Counseling	**Trac Prediction**
Goal. To support the decision-making of school directors in the enrollment and cancellation processes of subjects. **Adaptation process.** Complete tool design, inspired by visualizations of the tool LISSA (KULeuven). **Adoption status.** Piloted, available and in use for 47 UACh programs. Its operation is in the process of institutionalization. **Future implementations generated because of the piloting.** TrAC students, to support students' course enrollment decisions (implemented).	**Goal.** To support the early detection of students at risk of delay and/or abandonment of a certain program. **Adaptation process.** Complete tool design, with support from UC3M. **Adoption status.** Piloted **Future implementations generated because of the piloting.** Usability improvements of the tool itself (ideas). Adaptation of the tool to be used by the UACh student welfare unit (ideas).

PUC – Chile	
NMP	**DaP-MOOC**
Goal. To support the study strategies and self-regulation of students in MOOC courses, automatically and personalized. **Adaptation process.** Complete tool design, inspired by visualizations of the tool. **Adoption status.** Piloted **Future implementations generated because of the piloting** Adapt the NMP tool for other LMS, such as MOODLE (ideas).Summary visualizations for teachers (ideas).	**Goal.** To support the early and automatic detection of students at risk of dropping out in MOOC courses. **Adaptation process** : Complete tool design, inspired by visualizations of the tool, with support from UC3M. **Adoption status.** Piloted **Future implementations generated because of the piloting.** Improve the integration of the tool itself. A new tool for monitoring messages (ideas).

UCuenca	
AvAc Counseling	**AvAc Prediction**
Goal. To support academic counselors with information on the curricular progress and academic performance of students. **Adaptation process.** Complete tool design, inspired by visualizations of the tool LISSA (KULeuven). **Adoption status.** Piloted, available and in use for 12 faculties of the UCuenca. Its operation is in the process of institutionalization. **Future implementations generated because of the piloting.** Usability improvements of the tool itself (ideas).	**Goal.** To support the early detection of students at risk of dropping out of a certain program. **Adaptation process** : Complete tool design, inspired by visualizations of the tool, with support from UC3M. **Adoption status.** Piloted **Future implementations generated because of the piloting.** Usability improvements of the tool itself (ideas).

ESPOL	
SiCa Counseling	**SiCa Prediction**
Goal. To support academic counseling sessions with concrete data on curricular load. **Adaptation process.** Incorporation of new visualizations to an existing tool, inspired by visualizations of the tool LISSA (KULeuven). **Adoption status.** Piloted, available and in use for all ESPOL on an institutional basis. **Future implementations generated because of the piloting.** Usability improvements of the tool itself (implemented).	**Goal.** To support the early detection of students at risk of dropping out of a certain program. **Adaptation process.** Complete tool design, inspired by visualizations of the tool, with support from UC3M. **Adoption status.** Piloted, available and in use for all ESPOL on an institutional basis. **Future implementations generated because of the piloting.** Usability improvements of the tool itself (implemented).

UChile NMP	UPS AvAc (Counseling & Prediction)	UFRPE OnTask	ITZ DaP-MOOC
Goal. To support the study strategies and self-regulation of students in MOOC courses, automatically and personalized. **Adaptation process.** Adoption of the existing NMP tool, with the support of PUC-Chile. **Adoption status.** Piloted	**Goal.** To support academic counselors with information on the curricular progress and academic performance of students and probabilities of dropout risk. **Adaptation process**. Adoption of the existing AvAC tool, with the support of UCuenca and UC3M. **Adoption status.** Pilotada, disponible y en uso para toda UPS de manera institucional.	**Goal.** To improve the academic experience of students by delivering timely, personalized and executable information throughout their participation in a course. **Adaptation process.** Adoption of the existing tool. With support from the University of Edinburgh. **Adoption status.** Piloted	**Goal.** To detect students at risk of dropping out in the different technological careers. **Adaptation process.** Adaptation of the existing AvAc and SiCa prediction tool, with the support of UCuenca and UC3M. **Adoption status.** Piloted

Figure 4-1. Summary of piloted tools, which details the purpose of the tool, how it originated, its current adoption status, and the ideas for future implementations generated because of the piloting.

4.1 Chapter Structure and Piloting Methodology

This document is divided into three main sections. These are:

- **Summary of pilots**. This section summarizes the context of each participating university, the tools piloted and the main results obtained during the pilots.
- **Detail of the pilots**. This section describes the detail of the execution of the pilots. It describes the planning carried out in each participating university, addresses the summary of the execution, and closes with results derived from each of the phases defined for the execution of the pilots.
- **Summary of results**. This section summarizes the results obtained after the execution of the pilots, the common difficulties encountered by the participating universities, as well as the strategies arising from this experience that the participants recommend for dealing with these difficulties.

The four overall objectives defined for the pilots were as follows:

1. Integrate LALA tools into the institutions' academic process to improve academic decision-making.
2. Develop local capacity to introduce LA tools in the institutions involved in the LALA project.
3. Collect data to evaluate student performance and the usefulness and impact of LA tools in institutions.
4. Ensure the sustainability of the use of LALA tools in the universities of all Latin American partners.

As mentioned, to achieve these objectives the pilots were organized in the following five phases:

1. **Preparation**. The first phase (preparation) included the development of the piloting devices (instruments), the socialization of the pilot plan with the stakeholders and the training of the piloting staff.
2. **Agreement**. The second phase (agreement) enabled the generation of an agreement with the project participants, establishing the commitments with each one of the stakeholders involved (teaching staff, students, etc.) and the safeguards applicable to the information gathered during the piloting.
3. **Training**. The third phase (training) included the training of technicians, users, and administrators, for the use and maintenance of the piloted tools.
4. **Use**. The fourth phase (use) allowed participants to use the tools in their academic processes and also included accompanying the participants, socializing the experiences, and a preliminary evaluation of the tools and the process.
5. **Improvement**. The last phase (improvement) enabled the general evaluation of the tools and the piloting, which allowed for documentation of the lessons learned that will form part of the LALA Handbook (final product arising from the work of the LALA project).

It should be noted that the piloting phases may appear to be sequential, but in practice their execution was iterative. Therefore, during a pilot, multiple instances of preparation, agreement, training, use and improvement can occur. However, these experiences are included in a single pilot project because the objective is common, and the tool evaluated is the same.

Each participating university has conducted at least one pilot for the counselling tool and one pilot for the prediction tool. In addition, one university also piloted the OnTask tool. During the execution of each of the pilot phases, each of the Latin American partners was free to carry out their own implementations according to their contextual needs. As will be seen below, the training and evaluation processes and instruments present some differences, as they respond to the nature and contexts of use of the tools. However, as can be seen in Table 4-1, there are many common aspects, and the methodology is common to all cases.

Table 1 summarizes the evaluation methodology with which each institution of the consortium assessed the achievement of the project indicators and their link to the overall objectives.

Short term indicators			Institutions			
Objectives	**Indicators**	**Evaluation methodology**	**UACh**	**PUC Chile**	**UCuenca**	**ESPOL**
1. Integrate LALA tools into the academic process of institutions to improve academic decision-making. 2. Develop local capacity in the institutions involved in the LALA project to introduce LA tools.	A total of 300 decision makers are involved in the pilots.	Number of teachers involved who can potentially use the tools	*	*	*	*
		Tool use log analysis, considering at least the following metrics: -Amount of application revenue per user. -Number of actions per user. -Tool use time.	*	*	*	*
		Analysis of attendance lists. Number of participants in classroom educational activities.	*		*	*
	At least 5000 students in total involved in the pilots.	Tool use log analysis, considering at least the following metrics: -Number of students involved. -Number of actions involving students (either by students themselves or by counsellors). -Tool use time	*	*	*	*
3. Collect data to evaluate student performance and the usefulness and impact of LA tools in institutions.	The advice and guidance of the teaching staff is more focused on the needs of each student, based on their data and that of previous students.	User evaluation survey (counsellors and students), considering at least the following aspects: -Perceived level of satisfaction. -Perceived level of utility. -Perceived level of decision quality.	*	*	*	*

		Survey evaluating the perceived usefulness of the tools by students and counsellors.	*		*	
		Guided discussions with counsellors, where they evaluate: -Effects on the use of time. -Effects on the number of errors in their decisions. -Impacts on the curriculum.	*			
4. Ensure the sustainability of the use of LALA tools in the universities of all Latin American partners.	The tools serve as an example for new ideas and implementations.	User interviews: list of proposed improvements to the tools.	*	*	*	*
Long term indicators			**Institutions**			
Objectives	**Indicators**	**Evaluation methodology**	**UACh**	**PUC Chile**	**UCuenca**	**ESPOL**
3. Collect data to evaluate student performance and the usefulness and impact of LA tools in institutions.	There are positive differences in the performance of students who receive counselling through the tools developed as a result of the project	Difference in the pass rate of courses (pre- and post-tool).			*	*
		Difference in ranking position (pre and post-test for students involved).	*			
		Difference in the pass rate of courses (students with and without tools).		*		
1. Ensure the sustainability of the use of LALA tools in the universities of all Latin American partners	There are at least 8 institutions in Latin America that regularly use Learning Analytics tools to make informed decisions.	Number of collaboration agreements signed with Latin American universities.	*	*	*	*
		Number of institutions using learning analytics tools	*	*	*	*
		Number of new repositories for versioned projects.	*	*	*	*
	Institutions use tools to predict or estimate outcomes based on	Survey to evaluate the correctness, use and improvements that could be made to ensure the sustainability of the system	*			

	mathematical/statistical/ machine learning models and academic data.	Survey to evaluate correct use and improvements to ensure sustainability.		*		
		Survey to evaluate the correctness, use and improvements that could be made to ensure the sustainability of the system. Use logs to measure increased tool use			*	*
	Evidence-based decision-making	Survey assessing whether pilot participants recommend the tools and whether they plan to continue using them. Meetings established with the Department of Technology and Undergraduate Management for the institutionalization of the tools throughout the University.	*			
		Meetings established with the Management of the School of Engineering for the promotion of the tools in other MOOCs.		*		
		Meetings established with Deans for the institutionalization of the tools in other faculties			*	
		Meetings with the Vice-Chancellor to present the results of the incorporation of the tool and to encourage its use.				*

Table 4-1. Summary of the relationship between piloting objectives, indicators, and mechanisms for measuring different aspects of piloting.

It should be noted that the universities outside the consortium also carried out measurements regarding the usefulness and impact of the incorporation of the tools. However, because the pilots carried out by these institutions were in general shorter, and with more methodological variation, they have not been included in the previous table.

4.2 Summary of the Pilots

The following is a brief description of the pilots carried out at each of the participating universities. For each pilot, the tool piloted and the main results obtained in the evaluations carried out are described.

4.2.1 Pilot Projects at Universidad Austral de Chile (UACh)

UACh is a traditional private non-profit university located in the south of Chile. Since its founding in the 1950s, the university has focused on expanding the supply of higher education in the southern region of the country and is proud to be a leading social actor in expanding access to education. Currently, the university has 16,700 undergraduate students, 850 graduate students and 750 full-time faculty members.

Due to the social characteristics of its students, one of the university's main problems is the dropout rate in the first years of the degree, as well as the time students take to complete their degree programmes. To deal with this issue, in the last two years, the institution has implemented an LA solution for student academic counselling called TrAC (Trajectory and Curriculum). TrAC has tools that support counselling as well as early detection of students at risk (prediction).

4.2.1.1 TrAC Counselling Tool Pilot

TrAC for counselling is inspired by the LISSA dashboard (designed by KU Leuven), which allows one to visualize academic information about students overlaid on the structure of the study programme (see Figure 4-2). The tool's main objective is to support school heads who act as counsellors and make decisions regarding enrolment and withdrawal applications for the subjects that students take each semester.

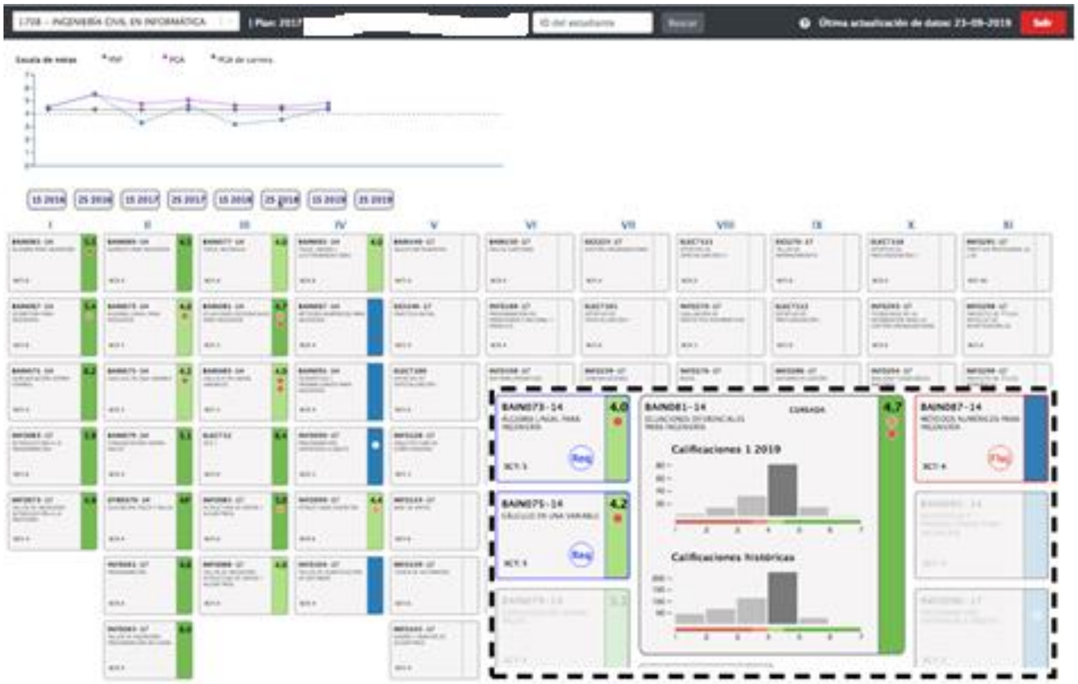

Figure 4-2. Screenshot of TrAC. The box with the border of dashed lines at the bottom right of the visualization is displayed when a course is clicked.

The TrAC pilot started in January 2019 and ended in December 2019. During this pilot, 21 directors from different programmes and three different campuses participated, as well as the University's Director of Undergraduate Studies. Participants represented about 30% of all programmes offered in UACh (all participants signed consent forms). Nevertheless, TrAC has been enabled for most university programs and students, therefore, they can be potential beneficiaries of the use of TrAC. More specifically, TrAC is enabled for 42 users that covers 9085 students.

Within the pilot, four face-to-face sessions were held to a) socialize the tool and collect baseline information, b) introduce the tool and provide training in its use, c) collect interim feedback and make improvements, and d) collect final comments on the usefulness and potential impact. Not all programme directors participated in all sessions. The sessions were held in groups to stimulate discussion among the directors of different degree programmes. Information was collected through guided discussions with open questions and surveys.

The first and second sessions focused on conducting a baseline survey, to understand how much work is required by special enrolment and dropout requests, how directors perceive the support available to carry out these processes, and what information is relevant for them to make informed decisions. The second session had to be postponed until the final days of the period in which the counsellors decide on the enrolment of a special course. Therefore, some participants either already had that job completed or the work was well advanced.

The baseline results reveal that both the number of special course enrolment requests to be resolved (from 50 to 300), and the time (each request more than five minutes) to be spent on this task is considerable. Therefore, the tool is useful and such usefulness was recognized by the users. More specifically, the directors welcomed the creation of a tool that could facilitate this process. They stressed the issue of having to access information from different parts of the current system, which results in increased use of time, confusion, and possible errors in decision-making.

The third session was held after one month with the aim of introducing some improvements in TrAC (e.g., show currently registered courses) and to collect comments on two aspects: perceived utility and perceived potential impact of TrAC. The results from the 11 counsellors who participated in this session show an overall positive and encouraging attitude towards the usefulness and impact of the tool. Counsellors find TrAC very useful, even though the tool was launched just before the end of the application period.

Counsellors reported using the tool to verify applications and inspect some student cases. Through impact and usefulness assessment surveys, it was possible to show that counsellors believe that TrAC allows them to make better decisions, to better explain these decisions, and to potentially reduce errors. They would also like to continue using the tool. Interestingly, the survey also revealed that TrAC has not necessarily changed the process they follow for resolving requests, nor provided new or additional information. Guided discussions explain these results: TrAC provides the same information that is already available, but collected on one easy-to-use screen, avoiding the need to go back and forth between different sections of the current system and thus saving time. However, they still have to use the current system to submit application decisions. At least two participants quickly detected problems in the curricular structure of the programmes. These problems had not been noticed before in the current system, and this had led to an increasing number of special requests.

Data automatically collected by TrAC (data collected from January to November 2019) shows different levels of use. The users as a whole inspected a total of 464 student situations (average number of situations 21.1) and performed more than 7000 actions (load student situation, click on courses to see statistics, click on semester to see subjects taken, etc). 59% of the participants (13) carried out more than 100 actions (maximum 1608).

Additionally, the impact of TrAC use on the performance of the students involved has been measured. To do this, an analysis was undertaken as to whether in 2019 these students have achieved a better position in the cohort ranking than in 2018. The results of this analysis show that after the pilot, 57% of the students improved their position in the ranking (a difference of 9.6 places on average).

The final session of the pilot focused on measuring the perceived impact with the aim of complementing the information already collected, informing the use indicators, and motivating the continued use of TrAC during the next period. In addition, the final session was planned to also involve new participants and extend the pilot; however, the extension of the pilot to the second half of 2019 was interrupted by the social revolution that began in Chile at the end of October 2019. Even so, a closing session was held in November 2019.

These results are encouraging, considering the following: events occurred which did not allow all the activities planned in the pilot to be carried out, and the UACh's teaching activities were interrupted.

For more details, see section 4.1 of this document.

4.2.1.2 TrAC Prediction Tool Pilot

At the UACh, the concept of student risk is a little explored concept, therefore within the LALA project the academic data of the students were analysed to generate a model that allows predicting the risk of dropping out of a career. Thus, a predictive component has been added to the TrAC tool that allows anticipating the needs of students who might require academic support from the school administration (see Figure 4-3). In this sense, TrAC moves towards stages of early detection of student risk to improve the decision-making process of both students and school directors.

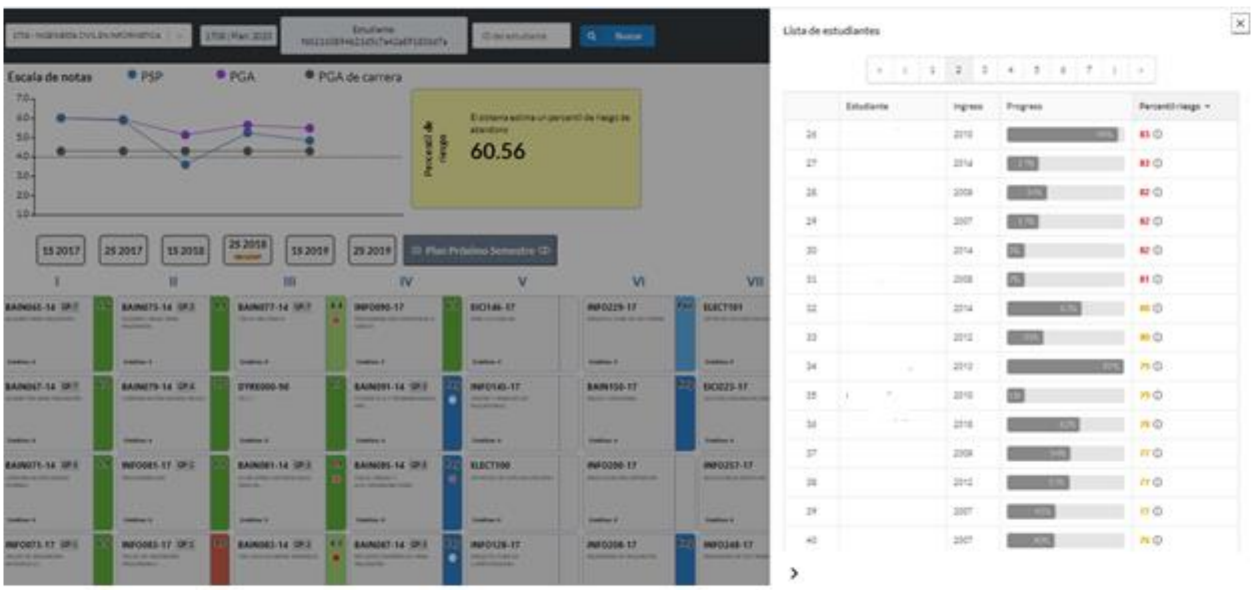

Figure 4-3. Screenshot of TrAC Risk. The list on the right presents the students and their relative risk relative to their fellow students. The yellow box next to the progress chart shows the dropout risk percentile that an individual student is in.

TrAC Risk pilot was intended to determine the impact of the proactive visualization of academic risk on the student risk analysis process by school directors. This process began in June 2020 and concluded in November of the same year. During this piloting, 2 program directors from different programs participated. Participants represent about 3% of all programs offered at UACh. In terms of students, these programs involve more than 800 students who can be potential beneficiaries of TrAC Risk. However, the predictive model is trained with data from the careers of the Faculty of Engineering Sciences. Therefore, it can be extended to the 8 careers of said faculty.

Within the piloting, two work sessions were carried out with school directors through virtual platforms, in which they had to: a) characterize student risk from an institutional, directives and personal perspective; and b) identify students with the highest student risk in their academic programs. Two sessions were carried out with the same purposes, one week apart and with the use of TrAC, in the first, and TrAC Risk, in the second. These were carried out individually to stimulate the reflection of each director about the variables, processes and strategies used in the analysis of student risk in their respective career programs. The information was collected through the recording of semi-structured interviews and responses to questionnaires.

The first session focused on performing a baseline survey, to understand how much work requires the analysis of student risk among students in academic programs, as well as the processes, roles and variables involved in such management.

The results of the baseline show that there is no unified or proactive student risk management process in the institution, but both principals take actions along this line to comply with the school management regulations. In particular, they mention some activities aimed at identifying students who could be at student risk, but, in general, they are not supported by academic management systems. Therefore, the directors who participated in the piloting showed different strategies for the identification and monitoring of students at student risk. Likewise, principals perceive the variables that cause academic dropout differently and, therefore, also differ in the way they approach this situation.

The second session focused on developing a reflective process about student risk, as did the first session and as an intra-subject validation mechanism. Likewise, student risk analysis tasks supported by TrAC Risk were carried out, analysing the behaviour and perception of the principals when using the variables and indicators provided by the extension of the ML tool.

The review of participants' behaviour recorded in the videos shows a positive evaluation of the information and the predictive strategy that was added to TrAC. In this session, student risk analysis patterns are observed with greater similarity among the directors, which is delineated by the variables and indicators presented by the predictive model and integrated with the visualization of the student's academic trajectory under analysis. Likewise, there is a tendency to recognize regular trajectories that influence student risk, both independent and dependent on the study program.

Based on the analysis of the TrAC questionnaires, videos and logs in the pilot period, positive results are appreciated, even when the sample is small, it is observed how the tool supports the proactive management process of student risk through a clear process based on variables and indicators that have a high level of coherence with the students' trajectories, which are visualized within the same TrAC tool.

For more details, check chapter 4.1.2 of this document.

4.2.2. Pilot Projects at Pontificia Universidad Católica de Chile (PUC-Chile)

PUC-Chile is one of the most prestigious universities in Chile and Latin America. It was founded by legislative decree in 1888 and was granted full academic and administrative autonomy in the late 1920s. Over the past century, it has become a large and selective institution, currently with five campuses and more than 1,200 full-time faculty members serving 32,500 undergraduate and 5,400 graduate students.

In 2015, the university's School of Engineering launched the UC Online initiative, which aimed to develop massive open online courses (MOOC) in search of new models to incorporate as part of their regular programmes. As a result of the initiative, the school began collecting large volumes of data on students from around the world, from demographics to how they interacted with the materials offered online. The institution saw this large volume of data as an opportunity to launch research initiatives related to LA, aimed at improving the experience of students and teaching staff in these new digital learning environments.

In this context, and within the framework of the LALA initiative, two projects are being developed. The first is a project for the development of a student-centred academic counselling system called NoteMyProgress (NMP). NMP supports students' study and self-regulation strategies in MOOCs and educational scenarios derived from these, through customized interactive graphics that are automatically generated for each student. Although a first prototype of the NMP tool was initially funded by Chile's National Commission for Science and Technology (CONICYT) between 2017 and 2018, its beta version is being completed within the LALA framework. Thanks to the LALA project, PUC-Chile has had the opportunity to pilot and improve the tool, enabling the development of a first stable and scalable version. Specifically, during the LALA project, PUC-Chile worked on the analysis of needs associated with the institution using the LALA framework, as well as updating the visualizations offered by the tool through two pilots, one with online MOOC courses (Section 3.2.1) and another in a MOOC course used in a classroom course following the flipped classroom methodology (Section 3.2.2).

The second project is the DaP-MOOC system, a dashboard for the prediction of dropout in MOOCs designed to support teaching staff in detecting groups of students at risk of dropout in MOOCs to facilitate their interventions in the course. The aim of the visualizations is to provide MOOC course assistants/tutors with a list of students classified by their probability of dropping out to offer personalized help messages to each of these groups, to retain them and avoid their possible dropout from the course. After several years of the MOOC initiative in the Engineering School (more than 24 courses with more than 500,000 students), the Engineering Education Directorate detected the need to provide a tool of this type to MOOC course assistants. The dynamization of the courses by the assistant lecturers in the MOOCs is a fundamental necessity in order to resolve the students' doubts regarding the courses and to keep their community active. However, the teaching staff in charge of this dynamization face two main difficulties: (1) they cannot distinguish between different groups of students at risk, so they cannot send personalized messages; and (2) they do not know what characterizes different groups of students, so they cannot send appropriate messages to each group. DaP-MOOC is an attempt to resolve these two main problems.

NoteMyProgress

NMP is a student-centred academic counselling tool that aims to support students' study and self-regulation strategies in online courses in an automatic and personalized way. Unlike the tools developed by the other partners, which offer analytics for academic programmes as a whole, this tool offers course-level analytics. Through interactive visualizations, NMP provides actionable aggregate information about student activity in the online course and students' interaction with its contents.

The tool is composed of a web platform and a plugin for Google Chrome. On the one hand, the plug-in offers the student the option of taking notes while studying the course, and simultaneously takes care of collecting the student's activity on the LMS. From this activity record, the web platform offers the student a visualization of the activity in a graphic and interactive way to facilitate the monitoring of his/her activities (see Figure 4-4). These two features provide support for student learning within the course.

A beta version of NMP existed at the institution before the start of the LALA project. However, during the LALA project, work was done on analysing needs and improving the dashboards offered, to create a first stable version for a first pilot. The needs of the students were evaluated in parallel to the development of the LALA framework (PUC-Chile led the development of the LALA framework), as well as the improvement of the dashboards in collaboration with KU Leuven.

For the evaluation of the tool designed during the first year of the project, two pilots were carried out, one in an online environment (section 3.2.2) and the other in a course following flipped classroom methodology (section 3.2.3). Both pilots were carried out between 2018 and 2019, corresponding to the beginning and end of the academic year in Chile.

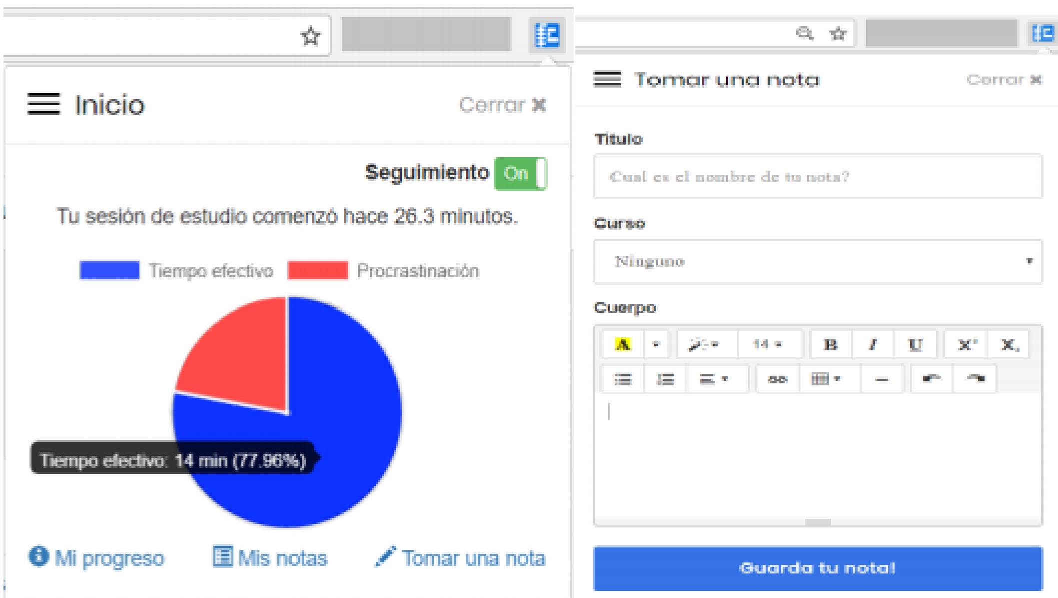

Figure 4-4. Screenshot of NoteMyProgress

4.2.2.1 Piloting NoteMyProgress Counselling Tool in an Online Environment

The first pilot of the NMP tool took place between January and July 2018. This first pilot was conducted to identify the needs regarding the use of the tool and was carried out in parallel with the definition of the LALA Framework. Specifically, work was done on the institutional analysis aspect to identify the needs of the institution and its main stakeholders (the students, in this case) to design a tool suitable for their needs.

The piloting of the NMP tool in an online environment took place between January 2018 and July 2018 involving 17 teachers. seven MOOC courses were offered by PUC-Chile through the Coursera platform. During the pilot period, these courses enrolled 19,052 students, of which 1054 installed the NMP tool on a voluntary basis, and 657 of them used the tool in some extent.

Due to the nature of this pilot (based on MOOCs), interactions with users were conducted electronically. The socialization of the tool was done through an e-mail, which presented the tool and explained the advantages that NMP offers as a complement to the course.

The installation of the tool was voluntary, and the students did not receive any remuneration for their participation in the pilot. All students who agreed to participate received an informed consent form.

For the pilot, students answered an electronic questionnaire on self-regulatory strategies. Training in the tool was conducted online through a manual. Towards the end of the pilot, students were asked to answer a questionnaire with closed and open questions about the use of the tool that allowed them to evaluate the tool in terms of three different dimensions: data, awareness, and reflection and impact.

Although the total number of students who downloaded the tool was 1054, for the analysis of the project's impact, a sample of only 263 subjects was considered, consisting of those who answered all the questionnaires provided during the pilot. Of these 263 subjects, registered for the courses "Managing Effective Organizations" and "Road to Project Management Excellence", 91 downloaded and used NMP and 172 did not. These two groups will serve as an experimental and control group, respectively.

The data automatically collected by NMP shows different levels of use. For example, students interacted with the tool 26,229 times on average and visited the course contents 43,491 times. This represents 11,788 more visits to the course materials than students who did not use the tool. These interactions translate into students showing a greater commitment to the assessments and video lessons; they completed more video lessons and started more supplementary activities.

In addition, to measure the impact on the performance of the students involved in the pilot, the results of these students were compared with the results of the students not involved. The results show that students who used NMP scored higher than students who did not use the tool. Finally, the results of the survey on the use of the tool show that students positively evaluate the data, awareness, reflection and impact dimensions of the visualizations offered by NMP.

Although the characteristics of the pilot study and the participant population do not allow us to extract conclusive results on the direct impact of the NMP tool on student engagement and performance, they do suggest that this tool could be a potential solution to motivate their activity in the course and, as a consequence, lead to an improvement in their performance. For more details see section 4.2.1 of this document.

4.2.2.2 Piloting NoteMyProgress Counselling Tool in a Flipped Classroom Course

The second pilot of the NMP tool was carried out in the context of the Universidad Católica's "Behaviour of Organizations" course between August and November 2018. The lecturer of this course, which was initially taught in a traditional way, decided in 2018 to transform his course following the Flipped Classroom methodology, also known as the inverted class (hereinafter, “flipped”). For this transformation, the lecturer wanted to take advantage of a MOOC course that he had created in Coursera a year before. For the course, this MOOC was slightly transformed to distribute its content over the 11-week face-to-face course, with the addition of questionnaires and new assessment activities linked to the face-to-face classes.

The flipped course is organized over 11 weeks, in which students must do activities before and during the two face-to-face classes they have per week:

- **Activities before class.** Students must carry out two activities: (1) review the MOOC's video lessons and (2) complete a week plan asking them for information about the week's goals and the time they plan to spend on each goal.
- **Activities during the class.** The face-to-face sessions are structured in two parts: (1) initial assessment, in which students answer a questionnaire about the videos they should have seen before the class, and (2) group work on the analysis of a case study.

The pilot involved 242 students, organized into a control group (n=109) (to establish the baseline) and an experimental group (n=133). Both groups carried out the same activities and completed the same type of evaluations. The only difference between the two groups was the use of NMP as a tool for planning and determining the week's objectives. While the experimental group used NMP for weekly planning, the control group did so through a form in *Survey Monkey*. All the students who were part of the pilot participated in a face-to-face training session to understand how to access Coursera and NMP (in the case of the group that used it).

The objective of this pilot was to evaluate the impact of using NMP to organize and plan their activities for the MOOC on the performance and involvement of students in the MOOC. For this purpose, the data logfiles of Coursera and NMP were analysed to recover the average number of interactions with the course activities and the NMP tool.

The results of analysing the activity of the two groups of students in the MOOC course show that: (1) the experimental group (which used NMP) showed statistically significant greater levels of activity than the control group and (2) the experimental group was more constant in their interaction with the course than the control group, which showed a decrease in activity in the MOOC from the beginning to the end of the course. For more details see section 4.2.2 of this document.

4.2.2.3 Dropout Prediction Tool Pilot

The Dropout Prediction Dashboard in MOOCs (DaP-MOOC) is a web dashboard designed to detect groups of students at risk of dropping out of MOOC courses early and to do so automatically from student interaction with the course's digital resources. A set of visualizations provides information about students and their number according to the probability of dropout (high, medium, or low risk). The aim of the visualizations is to provide MOOC course assistants/tutors with a list of students classified by their probability of dropping out in order to offer personalized help messages to each of these groups, to retain them and avoid their possible dropout from the course.

Below, you can see the first version of the tool visualization (Figure 4-5).

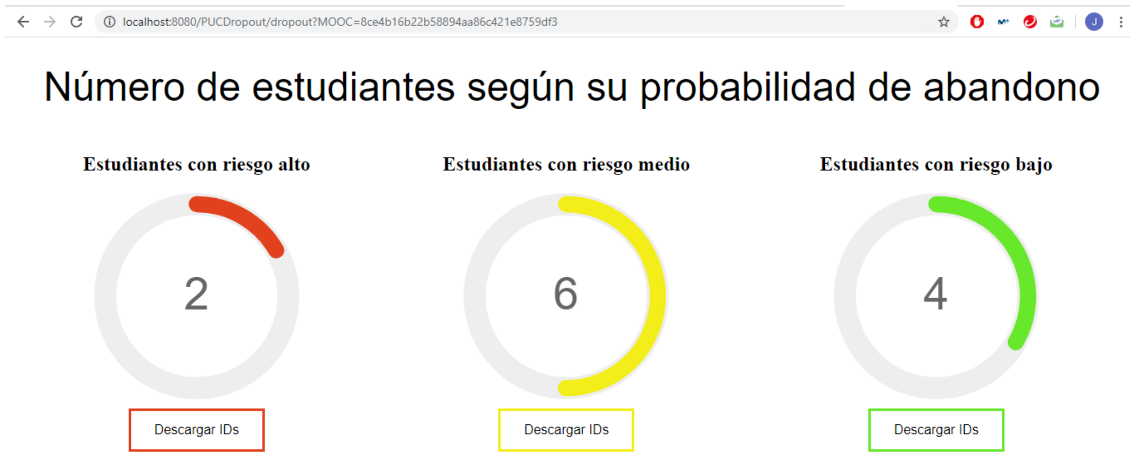

Figure 4-5. DaP-MOOC screen

The pilot study was structured in two stages. In the first stage, data was collected from 3 MOOCs offered by the PUC-Chile on the Coursera platform. These courses are: "Electrons in action" (N = 2,035), "Constructivist class" (N = 337) and "Management of effective organizations" (N = 526). The 3 courses focus on different target audiences, facilitating the diversity of study participants. The objective of this first pilot stage was to evaluate the validity of the proposed prediction models. For this, no visualization panels were used, but only data from previous years courses were used to improve the algorithms, draw conclusions about different variables that affect prediction, etc. Specifically, data from the course “Electrons in Action” collected between April and December 2015, and data collected between June and September 2019 for the other two courses were taken as a reference. As this first stage only has an objective of improving the algorithms, it is not considered for the total numbers of students, teachers, etc. of the pilots.

The second stage of the pilot was carried out in the course "Introduction to Programming with Python" (N = 2421) during the months of July and August 2020. In addition, two teachers participated in this pilot. In this second stage, the proposed visualizations, and their effect on students' commitment to the course.

The results of the second pilot show that the use of personalized messages according to the dropout risk group could have a positive effect on students categorized as medium risk. The data shows that these students evolve into less risky groups throughout the course. The same evolution is not observed for students classified into high-risk and low-risk groups. It is also observed that, from week 5, students who are transferred to groups with a low dropout risk remain in this group until the end of the course. Although it cannot be assured that these results have been influenced by the messages, we do observe a positive trend for medium-risk students, who could potentially become part of a low-risk group towards the end of the course.

In addition to the effect on students, the pilot points out that this tool can be useful to support the teacher in massive courses. From the perspective of the teachers involved, insights were obtained through informal interviews where they highlight the benefit of being able to have a visualization about the probability of dropping out of the different student groups and being able to send personalized messages accordingly. Finally, they also value being able to have "standard messages" to send to students that describe and interpret the data shown in the visualizations. For more details see section 4.2.3 of this document.

4.2.3 Pilot Projects at University of Cuenca (UCuenca)

The UCuenca is a public institution located in the centre of the southern region of Ecuador. It was founded by legislative decree in 1867. Its mission is to train professionals and scientists committed to improving the quality of life in intercultural environments and in harmony with nature. It currently has five campuses that house some 1,200 full-time faculty members, 16,600 undergraduate students in 12 faculties, and 930 graduate students. This university had no previous experience in LA at the time of this project. The leaders recognize that LA is a powerful tool to support students in their learning process, however, there is resistance that makes adoption difficult. This resistance is due to the additional workload required and the absence of policies that allow the allocation of working hours to this type of project. As a result, AvAc (Academic Advancement) was implemented, a tool to provide faculty and academic counsellors with information on the curricular progress and academic performance of students. Some of the faculties that are part of the pilot have started to use AvAc; however, initial resistance has been detected that will make its adoption difficult at the institutional level. This resistance is due to the additional workload required of staff who would carry out academic counselling activities and the absence of policies that would allow them to allocate working hours for this type of project; an aspect that should be taken into account in order to scale up AvAc at the institutional level.

4.2.3.1 AvAc Counselling Tool Pilot

AvAc, inspired by the LISSA dashboard (designed by KU Leuven), allows students to visualize their academic course of study in order to provide counselling (see Figure 4-6). It is divided into three visualizations that summarize the progress and performance of the studies. These show the curricular structure, courses and grades; and a graph of the student's average performance in a semester and the details of each semester, in terms of academic load, course performance and difficulty of the course.

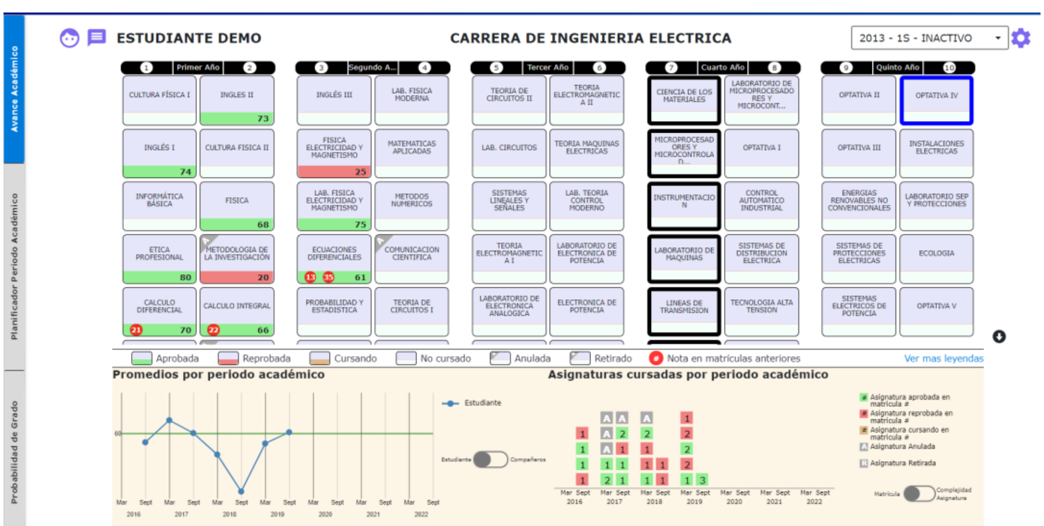

Figure 4-6. Screenshot of AvAc

Piloting in UCuenca began in July 2019 and will continue until September 2020, because the team faced the challenge of adopting a new tool and implementing a previously non-existent academic advisory process.

Eight face-to-face socialization sessions were held, in which 74 teaching and administrative staff participated. The sessions focused on: a) collecting baseline information, b) introducing the tool and training, c) inviting and motivating lecturers and staff to participate as counsellors, and d) collecting information on the tasks and processes needed to analyse students' academic progress.

Following these socialization sessions, and thanks to the support of the Dean, 48 enthusiastic lecturers have become involved. This represents eleven programmes belonging to four university faculties covering about 50% of the university's faculties. All participants signed an informed consent form.

For the baseline survey, teaching staff were asked about the current amount of work involved in special course enrolment applications, their perception of the support available to carry out the process and what information is relevant. The results revealed that it is important for the university to offer students face-to-face assistance during the application process, and to improve assistance in resolving applications for enrolment and withdrawal. Therefore, the usefulness of the tool was confirmed.

Also, the number of applications for special courses is 50 or more per school and each application takes between two and five minutes. Participants agreed to display the academic information as a dashboard, which will function much better than browsing through different reports. However, some participants were concerned about having additional workload because of the need to adopt both a tool and a counselling process.

Furthermore, after introducing some improvements in AvAc and in the counselling guidelines according to the comments gathered in the socialization sessions (e.g., showing the withdrawal from subjects per term, allowing the analysis of the historical structures of the programme), four face-to-face training sessions were held, one per faculty.

The data automatically collected by AvAc shows different levels of use. The number of actions performed on the tool is 22707. These actions correspond to 56 out of the 74 participating teaching staff actively using the tool and involve 1873 students.

The pilot evaluation sessions focused on measuring the perceived impacts and motivating the continued use of AvAc during the next period. The results obtained in these evaluation sessions show that more than 80% of the students believe (providing a rating of between 8 and 9 on a scale of 10):

- Seeing the visual tool makes them think about what they should do from that point on.
- Using the visual tool during the session helped them better understand the tips or suggestions.
- They would like to continue discussing their academic situation using the visual tool.

These overall results of the pilot show that AvAc is relevant in supporting academic counselling sessions and they lay the foundation for both scaling up at the institutional level and for future studies on its impact on student performance. For more details see section 4.3.1 of this document.

4.2.3.2 AvAc Prediction Tool Pilot

The tool for predicting dropout at UCuenca allows us to observe the probability of the student dropping out in a certain curricular map. This probability is calculated by means of machine learning algorithms and contains two visualizations integrated into the AvAc tool. The first one only shows the probability of dropout, while the second one (Figure 4-7) shows the variables used for the calculation in more detail and an explanation of each one for a better understanding of this percentage.

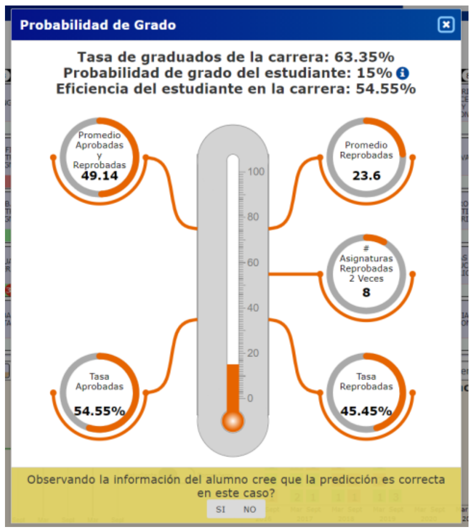

Figure 4-7. Visualization of the dropout prediction panel

In the case of UCuenca, the dropout prediction tool is integrated into the AvAc tool and therefore the procedure followed during the piloting stage is the same as in section Tool Pilot (see section 3.3.1).

It should be noted that the tool is a panel of the AvAc tool dashboard and therefore not all counsellors and students accessing the counselling tool necessarily have to display the prediction tool panel. Although in the training phase it was shown in the same way as the previous tool, of the 74 counsellors who have used the tools, 48 accessed the dropout prediction visualization and this was to make visible the probability of a total of 135 students. As in the case of the previous tool, a more extensive pilot is being planned for the beginning of the next semester where, in addition to the tests already carried out, the number of faculties has been increased from two to a total of five. The aim is to reach a total of 29 degrees in the five faculties in order to collect more data about the tool.

4.2.4 Pilot Projects at Escuela Superior del Litoral (ESPOL)

ESPOL is a public polytechnic university founded in Ecuador in the late 1960s. The university focuses on engineering related degrees with eight faculties.

The main campus has approximately 1,000 full-time faculty members and 12,000 students, including 10,300 in undergraduate and 1,700 in graduate programmes. ESPOL already has a counselling process for established students; this process seeks to reduce dropout rates in the early years. To this end, ESPOL has been working in recent years on improving its counselling tool (SiCa) for students, which has resulted in the development of new visualizations.

4.2.4.1 Piloting of New Counselling Visualizations in SiCa

In ESPOL the system used in counselling (SiCa) was improved by incorporating three visualizations (see Figure 4-8, one of them inspired by the LISSA dashboard, designed by KU Leuven. These visualizations show the courses taken each semester with grades, number of times taken, status (failed, passed), and who the lecturer was. For each course, details of average grades and the comparison with peers are shown. A second visualization shows the weekly workload (hours) and the difficulty of the courses added to the plan. The third view allows the inspection of the student's academic history by semester, including a summary and comparison of performance.

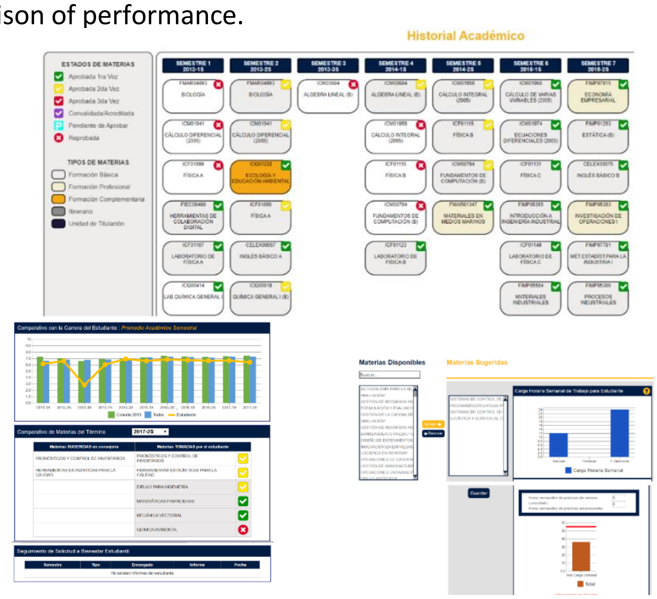

Figure 4-8. Screenshot of the three visualizations built into SiCa

The piloting in ESPOL began in March 2019 and ended in October 2020. Because ESPOL already had an institutional process for academic counselling, the new visualizations were tested in regular counselling sessions. As a result, the visualizations were made available to all university counsellors. During the training, which was attended by 187 lecturers, counsellors were asked for explicit consent to use their data during and after the training. This consent form was distributed by e-mail and signed electronically by 152 counsellors. However, as the new visualizations were made available to all counsellors, it was used by 416 lecturers, involving 9485 students, during the four semesters that the counselling pilot was conducted.

For the baseline survey, the 152 counsellors who signed the consent form were asked to answer a survey consisting of two questions before learning about the new characteristics. The first was a closed question ("The information currently provided by the counselling system is sufficient to make sound decisions to guide the student") and the second an open question, which covered the justification. The results of this survey show that satisfaction with the current counselling system is not complete, therefore, it endorses the usefulness of the incorporation of the new visualizations.

The training was conducted in one-hour face-to-face sessions and the new features were explained. In addition, participants were asked to respond to a satisfaction survey regarding the new visualizations. The results of this survey show that the visualizations are considered easy to access and navigate, and clearly display the information.

User interactions with the tool were collected through Google Analytics. This use data shows that the tool was consulted 37,804 times, during four semesters. In addition, not all counsellors used the same visualizations. More specifically, most of them used the visualization that allows them to know which courses are available to students, with 23,546 queries.

Additionally, the impact of the use of the tool on the performance of the students involved was measured. For this purpose, the average grade obtained by the students who received counselling during the first semester of 2018 and 2019 was analysed. The results of this analysis show that after piloting the average went from 7604 to 7632. This is not a significant difference, but even if it were, it would still not be possible to link it to the new visualizations. The student's average depends on many factors, both academic and personal. No comparative measurements were made in either of the two semesters of 2020 because the current educational context, caused by the pandemic, forced all classes to be online and could not be compared with a context of previous years when classes were 100% in person.

The final activity of the pilot was the evaluation of the tool after its use. For this purpose, participants were requested to respond to a questionnaire like the one used for the baseline survey. The results show improved results, and this is clear evidence of the usefulness of the new visualizations. Furthermore, freely expressed comments complemented this information and revealed a positive perception of the new features: "The information for counselling students is clearer and more accessible, allowing you to see what happened during the student's degree more quickly and easily, to understand the possibility that the student will fail the degree and to give recommendations that are more suited to the student's reality"; "The new functions are very useful to guide the student properly".

These general results of the pilot confirm the sustainability of the tool and show the commitment of the counsellors to the continued use of the tool. On the other hand, it is necessary to lay the foundation for future studies on the impact on student performance. For more details see section 4.4.1 of this document.

4.2.4.2 Piloting New Prediction Visualizations in SiCa

The dropout prediction tool used at ESPOL allows you to observe the probability of student dropout in a given curricular map. This probability is calculated by machine learning algorithms and contains a visualization dashboard integrated into the counselling tool (Figure 4-9). The visualization shows the variables used for the calculation in detail and explains each one for a better understanding of this percentage.

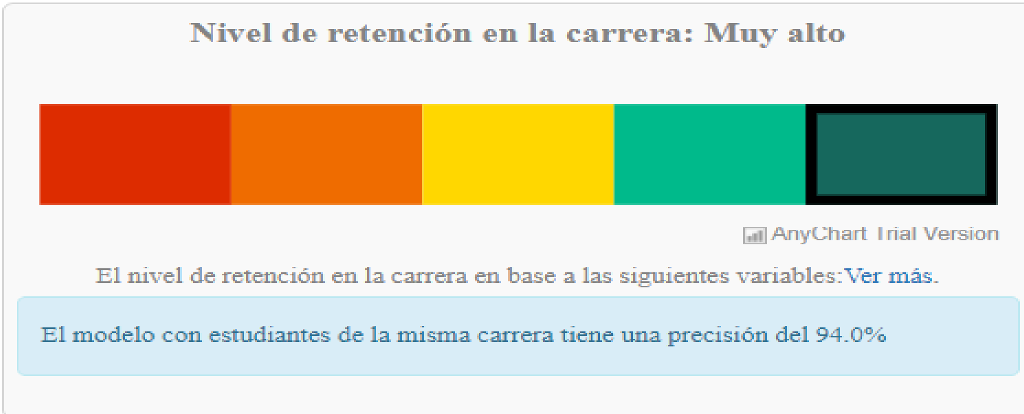

Figure4-9. Final version of the visualization of the dropout prediction tool

The tool is integrated with the new visualizations in the LA tool for counselling that the university already had. Therefore, the initial process was similar. The piloting of this tool started in March 2019 but as the calculation of the probability of dropout needed to be improved, it was decided to hide the visualization in order to proceed with an improvement of the predictive models. As mentioned in 3.4 Pilot Projects at the Escuela Superior del Litoral (ESPOL), the university already had a student counselling tool and counselling was already a regular practice at the school, therefore, the pilots performed at ESPOL needed to be more demanding and to offer good predictive accuracy.

In September 2019, a second small-scale pilot was carried out with a visualization that only expressed whether the student had a high probability of dropout (greater than 50%) and the first data regarding the use of the tool's visualization was collected. Finally, in 2020 the tool was shown during the two semesters.

The baseline survey and training were carried out in the same way as with the new visualizations mentioned above in 3.4.1 Piloting of New Counselling Visualizations.

User interactions with the visualization dashboard were collected through Google Analytics. The counselling tool was consulted by a total of 322 lecturers to advise 4850 students, but due to the short time available to the counsellors and the positioning of the prediction tool on the dashboard, only 12 lecturers and 24 students made use of it. Due to this lower use of the prediction tool and with the aim of increasing the number of interactions with it, it has been decided to position its visualization on the main dashboard in the next pilot.

After the small-scale pilot, the prediction algorithms have been improved and the final display has been implemented on the main screen of the counselling dashboard. The tool has been effectively used by 26 and 12 teachers during the first and second semesters of 2020 respectively. Nevertheless, the tool has been available to the 297 and 292 teachers who gave counselling in the first and second semesters of 2020 respectively.

4.2.5 Summary of Pilotings in Universities External to the Consortium

4.2.5.1 Pilot at the Universidad de Chile (UChile)

The Universidad de Chile is one of the oldest universities in Chile. It has 5 university campuses distributed in the metropolitan region of Santiago de Chile that offer more than 69 degree programs, in addition to 38 doctoral programs and 116 master's degrees.

One of the most active schools in the field of educational technology is the School of Economics and Business. This school has a Teaching and Learning Center that aims to promote teaching innovation and the use of technology for education. In 2015, the University became part of the group of universities in Coursera and this school, from the Teaching and Learning Center, began to produce MOOCs for its various undergraduate and graduate degrees. Currently, this university has 14 courses on this platform, which are offered both as courses open to all, and as complements to classroom courses.

From the beginning, the school has been interested in attracting students to its courses and has aimed to offer them the best possible experience. One of the problems they have focused on is trying to retain as many students as possible in their courses once they have registered. To this end, the Teaching and Learning Center has experimented with different interventions for this purpose and one of the solutions it proposed as an experiment is the use of NoteMyProgress, a tool to support student self-regulation in courses, which had already been tested at the Pontificia Universidad Católica de Chile. This section describes the pilot case of the use of this tool in four of the courses offered by the University of Chile.

4.2.5.1.1 Pilot of NoteMyProgress counseling tool at University of Chile

The NMP tool was piloted in four massive courses created by the University of Chile (Chile) and offered through Coursera between September and August 2019. The objective of this pilot was to understand if the use of NMP could be extended to other institutions that used NMP and to detect possible problems in the installation and use of the tool. Therefore, unlike the first pilot, where the interest was to understand the effect of the tool on students, this pilot aimed to understand the problems derived from the adoption of the tool by other third-party institutions, which had not participated in its development.

Due to the nature of this pilot (based on MOOCs), interactions with users were conducted electronically. The socialization of the tool was done through an e-mail, which presented the tool and explained the advantages that NoteMyProgress offers as a complement to the course. The installation of the tool was voluntary, and the students did not receive any remuneration for their participation in the pilot. All students who agreed to participate received an informed consent form. In sum, four teacher were involved in the piloting reaching 95 student of 1252 potential beneficiaries.

For the implementation of the pilot, two researchers/developers from the Pontificia Universidad Católica de Chile and the Director of Engineering Education, all participants in the project, and two people from the Universidad de Chile-- the director of the Teaching and Learning Center of the Economics and Business School of the Universidad de Chile and the systems manager of the same center-- were involved. The development of the pilot was carried out in different phases:

1. Initial phase: During the initial phase, the director of the Teaching and Learning Center of the University of Chile and the Director of Engineering Education held several meetings to explain the

objective of the NMP tool and the pilot, and the most appropriate courses were selected to launch the pilot.

2. Installation phase: The two researchers/developers from the Pontificia Universidad Católica de Chile involved in the development of the NMP tool and participants in the LALA project participated in this phase. In addition, the systems manager of the Teaching and Learning Center of the University of Chile was involved. Before the launch of the pilot, they interacted several times and in several meetings to (1) configure the tool to integrate the courses involved, and (2) coordinate the warning messages for the students in the courses. In addition, during the duration of the pilot, they all exchanged emails to find out if the pilot's follow-up was correct.
3. Completion phase: The two researchers/developers from the Pontificia Universidad Católica de Chile and the service manager of the Teaching and Learning Center of the Universidad de Chile coordinated to finalize the project and send the corresponding completion emails to the course participants.

After the pilot experience, the following conclusions were drawn:

1. The process of installing and configuring the tool for the adaptation of the different courses requires coordination between the two institutions, to ensure that the tool is used correctly.
2. A systems manager is required at the university where the tool is applied to ensure its proper functioning and to send messages to students to inform them about its use.
3. The final coordination of the project requires the involvement of systems managers and researchers if similar conclusions to those of the first pilot are to be reached. In that case, it is proposed that the methodology of analysis explained in chapter 4.5.1 of this document be followed.

4.2.5.2 Pilot projects at the Universidad Politécnica Salesiana (UPS)

The Universidad Politécnica Salesiana del Ecuador (UPS), created by Law No. 63, published in the Official Register No. 499 of August 5, 1994, is a private Catholic institution of higher education. Its main residence and headquarters are in the city of Cuenca with 25 years of experience in the different branches of university higher education. Among other things, its aim is to form people with human maturity who know how to make a coherent synthesis of ethics, life, and culture, so that they act in history in the line of justice, solidarity, and fraternity, bearing witness to the highest human ethical values. Currently, it has 3 branches in the main cities of Ecuador: Cuenca, Quito, and Guayaquil and with 7 campuses hosting more than 25,000 undergraduate students and around 1,500 graduate students. In collaboration with the LALA project, dashboards have been adapted to implement the academic counseling process at the institution supported by a tool that allows the analysis of the curricular progress and academic performance of students including early grade prediction.

In March 2020, the city of Guayaquil became the epicenter of the COVID-19 pandemic. The Academic Vice-Rector's Office and the Vice-Rector's Office of the Guayaquil Branch decided that it was the most opportune moment to start implementing a pilot project in the Guayaquil Branch of the academic counseling project during the academic period from April to September 2020, in which all the courses in the Guayaquil Branch decided to participate on a voluntary basis.

The Guayaquil campus has approximately 7000 students in 18 undergraduate degree programs who voluntarily got involved and all the degree programs decided to participate with 119 professors with the goal of reaching 50% of the students.

4.2.5.2.1 Piloting of counseling tool in SCA

The Academic Counseling System (SCA) is an adaptation of the AvAc dashboard, designed by the University of Cuenca in the context of the LALA project, which allows the visualization of the academic trajectory of the students to provide counseling (see Figure 4-10) and to monitor the progress and performance of the studies. SCA allows you to see the curricular structure, the subjects in the degree program, grades, a graph of the student's academic performance in a semester and the details of each semester, graphs of academic load, the difficulty of the subjects, details of the activities carried out in the AVAC virtual classroom (Moodle), the last connection to this subject in the virtual classroom, personal information with contact details, grants, and foreign language data.

Figure 4-10. Screenshot of SCA

The pilot project at the UPS Guayaquil Headquarters began in May 2020. Degree program directors and volunteer teachers were trained in the SCA tool, to provide accompaniment during the COVID-19 pandemic.

Sixteen socialization and training sessions were carried out through the Zoom and Webex Cisco platform in which 119 teachers and 16 degree program directors participated. The sessions focused on introducing the tool and giving guidelines on counseling.

Those responsible for distributing the students to their professors were the directors of all the degree programs at the Guayaquil headquarters. 3668 student received counseling in during the piloting.

The data collected by the SCA shows different levels of usage. The number of actions carried out in the tool at the end of the pilot period was 26,074 actions corresponding to the participating tutors who actively use the tool and involve 3,668 students.

In order to evaluate the academic counseling pilot at the end of the cycle, students were sent a survey asking how they would rate the approach of the person who contacted them to talk about their personal situation. Through that, positive results were obtained, with students giving these ratings: 81.59% as friendly, 11.26% said they felt the tutor was interested in their situation, 4.29% warm, and 2.87% Other.

Using the SCA made teachers have personalized conversations with each student. These general results of the pilot show that the system implemented is relevant for the support of academic counselling sessions and lays the foundation for scaling it up at the institutional level as well as for future studies on its impact on student performance.

For more details see chapter 4.5.2 of this document.

4.2.5.2.2 Prediction Tool Pilot in SCA

The Undergraduate Prediction Tool at the UPS allows you to see the likelihood of a student graduating from a certain degree program (degree prediction). This probability is calculated using machine learning algorithms and contains two displays integrated into the SCA tool. The first one only shows the probability that a student will graduate from a certain degree program while the second one (Figure 4-11) shows in more detail the variables used for the calculation and an explanation of each one for a better understanding of how different variables influence that degree probability.

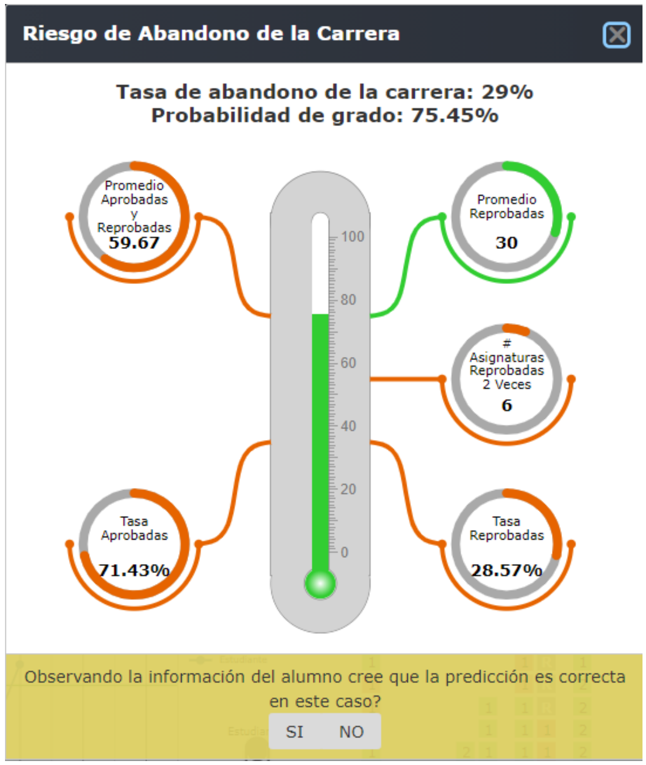

Figure 4-11. Abandonment Prediction Panel Display

It should be noted that the SCA academic counseling tool also includes grade prediction, that is, it is a functionality that can be seen as part of the counseling. As with the University of Cuenca, everything is integrated and therefore the pilot procedure was carried out in conjunction with the counseling pilot (see section 3.5.1 Counseling Tool Pilot in SCA 3)

Of the 119 tutors who have made use of the SCAs, 511 actions have been performed to display the student information in which the grade prediction thermometer is contained and 87 actions to view the grade probability in detail.

The positive evaluation of the UPS authorities, as well as those involved in the SCA pilots, has enabled the institutionalization of SCA. Evidence of this is that the superior council of the Universidad Politécnica Salesiana in RESOLUTION N°199-10-2020-09-16 resolves: "To approve the "Instructions for Academic Councils" presented by the Academic Council, whose implementation will be in force from the 57th academic period (2020 - 2021) at the national level."

For more details see chapter 4.5.2 of this document.

4.2.5.3 Pilot Projects at Federal Rural University of Pernambuco (UFRPE)

Federal Rural University of Pernambuco (UFRPE) has 104 years of tradition. UFRPE was founded in 1912, offering one course, and now it covers 59 undergraduate courses, including Administration, Economics, Physical Education, Gastronomy, Information Systems, Computer Science and several Engineering in different campus, as well as Distance Education. UFRPE has more than 1200 professors, more than 1000 technicians and around 17000 students. UFRPE has achieved good results due to investments in teaching, research and extension actions.

However, in Brazil, low completion rates of undergraduate programmes (33%) have been a persistent issue in higher education (OECD, 2019), and UFRPE is no exception. Students at UFRPE have frequently complained to the course coordinators about the lack of interactions with the instructor outside the class sessions. Although it is recognised that feedback plays a crucial role in learning success and the overall learning experience, the teaching staff are generally overwhelmed with teaching and administrative activities, which are time consuming and demanding.

In this context, it was decided that UFRPE would benefit from the adoption of the counselling tool, the early dropout prediction tool and On-task. However, due to COVID-19, among others unexpected events, only OnTask has been successfully piloted to date.

4.2.5.3.1 OnTask Tool Pilot

The OnTask tool aims to improve the academic experience of students through the delivery of timely, personalized and actionable student feedback throughout their participation in a course. To do this, OnTask gathers and assesses data about student's activities throughout the semester and allows instructors to design personalized feedback with suggestions about their learning strategies (See Figure 4-12). By providing frequent suggestions about specific tasks in the course, students will be able to quickly adjust their learning progressively. The tool receives its data from various sources such as video engagement, assessments, student information systems, electronic textbooks, discussion forums, etc. Instructors and educational designers can use the platform to connect large data sets about students with concrete and frequent actions to support their learning. Examples of feedback OnTask can facilitate include directing students to specific chapters or worked examples in their textbook, suggesting additional reading or resources, enrolling them in required workshops or laboratory tutorials, suggesting the most effective study techniques for the tasks in the course, directing them to university support services, etc. The tool is also designed to provide evidence to management bodies about student support actions and their impact on the overall learning experience.

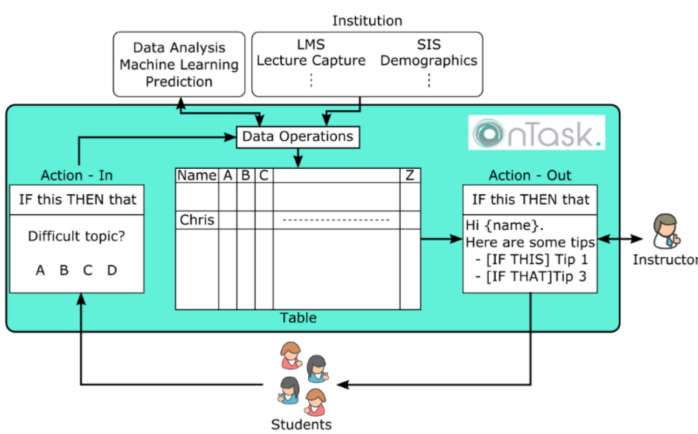

Figure 4-12. Workflow in OnTask.

OnTask pilot at UFRPE started in August 2019 and ended in December 2019. During this pilot, 3 instructors from the computing department taught 3 courses using OnTask to provide personalized feedback (all participants signed consent forms). In terms of students, these courses involve 112 students.

Within the pilot, one day face-to-face session was held to socialize the tool and provide training about its use. After the use of OnTask, informal interviews were held with the instructors and information was collected from the student by a survey.

The aim of the survey was to evaluate student experience with the feedback that you have received from your instructor using OnTask. Also, this survey helps the extent of the improvement in feedback practices at the UFRPE.

From the informal interview with instructors and logs analysis, we can conclude that: OnTask is easy to use for instructors with computer science background;3-4 session of 30-40 minutes each are needed to prepare weekly feedback.

Form the survey response we can conclude that: students show highly appreciate of feedback practice; students were generally satisfied with the feedback received through OnTask. From the impact perspective, due to the feedback, students declare that they can develop and adjust learning strategies and are motivated to work towards a desired goal. Additionally, students declare OnTask is useful because they receive opportune feedback and help to mapping with goals in the course.

For more details, see section 4.5.3 of this document.

4.2.5.4 Pilots in Instituto Tecnológico de Zitácuaro

Instituto Tecnológico de Zitácuaro is a higher education institution from Mexico. In collaboration with the LALA Project, an early dropout prediction tool has been adapted.

4.2.5.4.1 Pilots with the prediction tool

The early dropout prediction tool is an adaptation of the tools developed in the LALA project. In this case, for the pilot, there are no graphical interface but the prediction results are presented to the actors in a textual form.

The pilot revealed acceptable prediction results, but there is room for improvement. A qualitative analysis revealed interest in the tool but there are different issues to improve.

For a more detailed description, please see chapter 4.5.4 of this document.

4.3 Detail of the Pilot Projects

4.3.1 Pilot Projects at Universidad Austral de Chile (UACh)

4.3.1.1 TrAC Counselling Tool Pilot Project

The TrAC (Trajectory and Curriculum Advisory) tool allows school directors (programme directors) to view academic information about their students superimposed on the curriculum structure.
The main objective of the tool is to assist school directors in making decisions regarding enrolment and withdrawal applications for courses that students take each semester, mainly at the beginning of the semester, based on the possibility of visualizing, in an integrated manner, the structure of the curriculum of each student (courses, semesters, requirements), and the performance of students in courses (grades, withdrawals, repetitions).

Resources

The resources used for the execution of the pilot project were as follows:

- Server to host the tool
- Computer technician for service support (tool availability)
- Project researchers for data collection and analysis
- Pilot Team
    - **Project Coordinator**
    - **Specialists in technological infrastructure**
    - **Group for training, pilot project support and monitoring**
    - **Administrative Assistant**
- Participants. The target audiences to be reached within the university are:
  End users: directors of schools of the Faculty of Engineering Sciences and of the degree programmes in English Pedagogy, Nursing, Chemistry and Pharmacy, Medical Technology, Occupational Therapy and Veterinary Medicine.
  Managers: Dean's team of the Faculty of Engineering Sciences, Director of Undergraduate Studies, Director of Institutional Analysis and Accreditation Officer.
  Others Involved: Directorate of Information Technology and Head of Computer Science at the Institute of Computer Science.

Planning

Table 4-2 presents the phases, activities, dates, methodologies, efforts, and artefacts planned for the execution of the pilot project. During the execution of the project, these phases were adapted to various emerging situations, such as the rescheduling of academic activities following student strikes.

Phase	Activity	Start date	Termination date	Methodology
Preparation	Artefact development		25/01/2019	Development of artefacts such as presentations, email support.
	Socialization of the pilot plan with stakeholders		16/01/2019	Socialization Conference (directors of the schools of Engineering and English, Nursing, Chemistry, Pharmacy, Medical Technology, Occupational Therapy, Veterinary Medicine, Dean and Staff) Socialization workshop
	Training of pilot programme staff	14/01/2019	25/01/2019	Pilot staff training workshop (student working toward a degree)
Agreement	Agreement with the participants		25/01/2019	Project meeting
Training	Training for technicians	27/02/2019	15/03/2019	Training workshop for technicians
	Training for users	27/02/2019	15/03/2019	Training workshop for users (school directors who signed agreement)

	Training for administrators	27/02/2019	15/03/2019	Training workshop for administrators (Dean's Team, Undergraduate Director, Institutional Analysis Office, Accreditation Office)
Use	Accompanying users	16/03/2019		Face-to-face support Remote support
	Socialization of experiences		April, May, July 2019	Workshop of socialization of experiences (1st Report of the experience, 2nd Report of the experience, 3rd Proposals of continuity of use)
	Evaluation		April, May, July 2019	Partial evaluation workshop
Evaluation and Improvement (includes internal work)	General evaluation	04/2019	08/2019	Evaluation study
	Documentation of improvements	05/2019	09/2019	Documentation of improvements

Table 4-2. TrAC counselling pilot planning

A description follows of the development and results obtained after carrying out each of the activities in the phases mentioned in Table 4-2.

Phase 1: Preparation

Processes included in the pilot project

During the pilot, the process of deciding on special course enrolment and withdrawal applications was included. This process does not currently have a decision support system, so the TrAC (Trajectory and Curriculum) tool is incorporated into it.

This tool allows school directors (Program Directors) to visualize academic information about their students overlaid on the structure of the curriculum. The main objective of the tool is to assist school directors in making decisions regarding enrolment and withdrawal applications for courses that students take each semester, mainly at the beginning of the semester, based on the possibility of visualizing, in an integrated manner, the structure of the curriculum of each student (courses, semesters, requirements), and the performance of students in courses (grades, withdrawals, repetitions).

The dates on which the enrolment and withdrawal processes are carried out are defined in the university's academic calendar. The following table 4-3 shows the detail of each one:

FIRST SEMESTER of 2019	
18 to 29 March	Period in which the Schools receive applications for enrolment of subjects corresponding to the first semester 2019.
1 to 12 April	Period for school directors to resolve subject enrolment requests, according to applications made by students.
15 to 29 May	Period in which the Schools receive requests for the withdrawal from subjects corresponding to the first semester 2019.
30 May to 12 June	Period for school directors to resolve student requests to cancel courses.
Second semester 2019	
12 to 23 August	Period in which the Schools receive applications for the enrolment of subjects corresponding to the second semester 2019.
26 August to 6 September	Period for school directors to resolve subject enrolment requests, according to applications made by students.

12 to 23 October	Period in which the Schools receive requests for the withdrawal from subjects corresponding to the first semester 2019.
24th to 30th October	Period for school directors to resolve student requests to cancel courses.

Table4-3. List of relevant pilot activities

Current situation of the processes included

Information was collected that offers evidence on the situation currently faced by school directors in terms of the tasks related to the processes of resolving enrolment and withdrawal applications for courses (baseline). The information collected has served to measure the relevance and impact produced by the incorporation of the TrAC tool. The instrument used to collect this information, the population surveyed, and the results obtained are detailed below.

Utility and impact baseline

For the baseline survey, two face-to-face surveys were conducted with school directors. Baseline Survey (ELB): “Baseline" or "Diagnostic" survey (UACh Annex 1) and EPPA: "Perception of the Application Process Survey" (UACh Annex 2). These surveys assess the following aspects.

1. Perception of time compared to various other tasks related to the post.
2. Perception of the number of applications that must be answered at the beginning of each semester.
3. Perception of amount of time needed to resolve a request.
4. Perception of the support they receive from the university to perform the task.
5. Importance of the university offering a support service in the application process.
6. Self-reported level of trust in enrolment and withdrawal decisions.
7. Perception of the importance of reviewing academic records and identifying relevant information
8. Number of students per school.

In the first survey (ELB) a total of 27 faculty directors participated and in the second survey (EPPA) a total of 20 faculty directors participated, corresponding to faculties at the Valdivia Campus and Puerto Montt Campus detailed in Table 4-4.

Faculty	Quantity ELB	Quantity EPPA
Faculty of Engineering Sciences	8	5
Faculty of Medicine	4	3
Faculty of Philosophy and Humanities	1	1
Faculty of Agricultural Sciences	1	1
Faculty of Sciences	3	2
Faculty of Architecture and Art	2	2
Faculty of Law and Social Sciences	1	1
Campus Puerto Montt	7	5
Total	**27**	**20**

Table 4-4. Faculty directors participants by each survey.

In general, the results of the surveys show that the process of resolution of applications (process to be involved in the pilot) can be improved. Their improvement could impact the quality of decisions, decrease the time dedicated to this work and also generate greater satisfaction with the support provided by the university.

The results obtained for each aspect evaluated in the surveys are described below.

1. Perception of time compared to various other tasks related to the post.

62.9% of those surveyed considered that the amount of work involved in dealing with special subject enrolment and withdrawal requests at the beginning of the semester was greater than other school management tasks (figure 4-13).

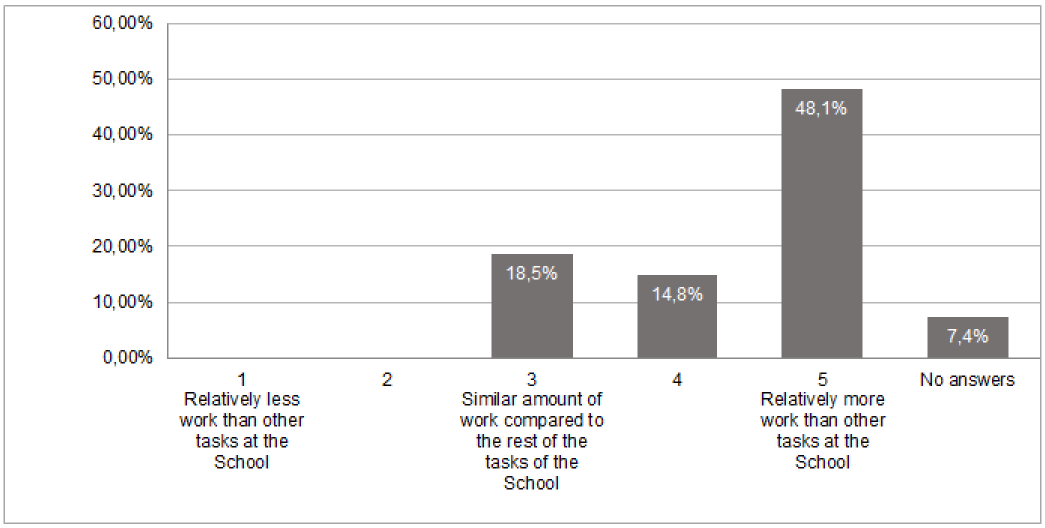

Figure 4-13. Perception of time compared to other tasks of the post.

2. Perception of the number of requests to be answered at the start of each semester (figure 4-14)

- 51.9% of those surveyed resolved more than 50 applications for enrolment of subjects online at the beginning of each semester.
- 44.4% of those surveyed resolved between 11 and 50 applications for enrolment of face-to-face courses each semester and another 25.9% resolved more than 50 applications.
- 59.2% of those surveyed resolved between 11 and 50 requests for withdrawal from online courses during the semester.
- 66.6% of those surveyed resolved between 1 and 25 requests for the withdrawal from face-to-face courses during the semester.

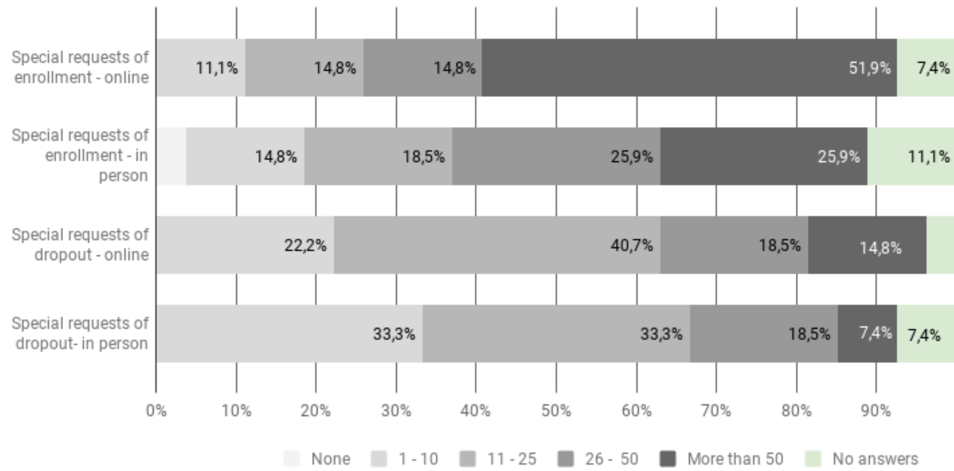

Figure 4-14. Number of requests**.**

3. Perception of amount of time to resolve a request (figure 4-15)

- 40.7% of respondents take an average of 5-10 minutes to complete each online course enrolment request.
- 44.4% of respondents take more than 10 minutes on average to complete each application for face-to-face courses.
- 44.4% of respondents take an average of 5-10 minutes to process each online course withdrawal request.
- 40.7 % of respondents take more than 10 minutes on average to deal with each request for withdrawal from face-to-face courses.

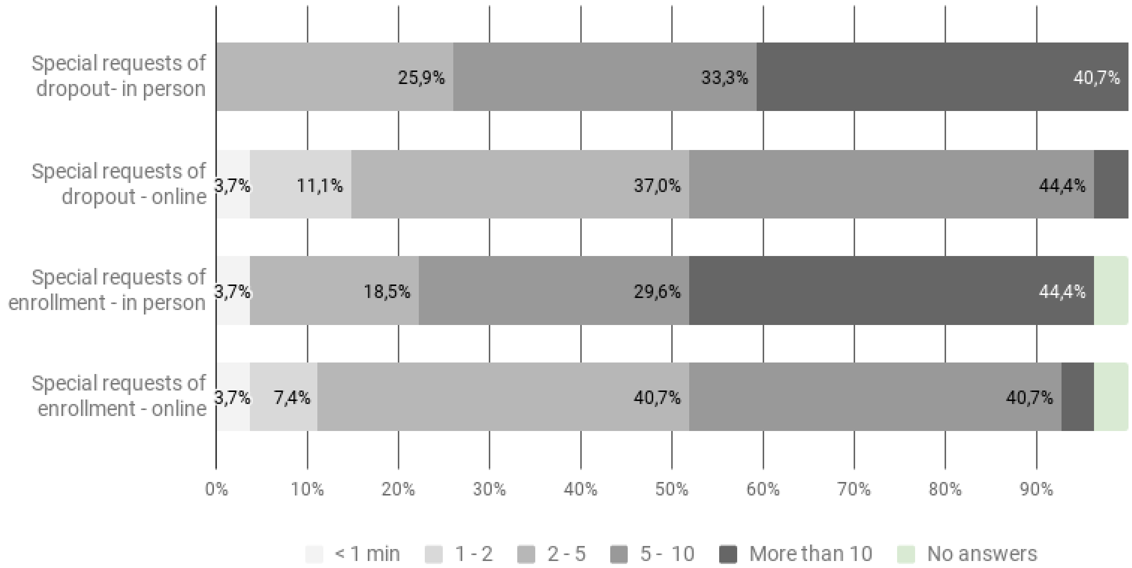

Figure 4-15. Estimated time to resolve requests.

4. **Perception of the support they receive from the university to perform the task (figure 4-16)**

- 55% of the respondents agree completely to partially that the University provides tools and information needed to resolve enrolment and withdrawal applications effectively.
- 45% of respondents moderately to strongly disagree that the University provides the tools and information needed to resolve enrolment and withdrawal applications efficiently.

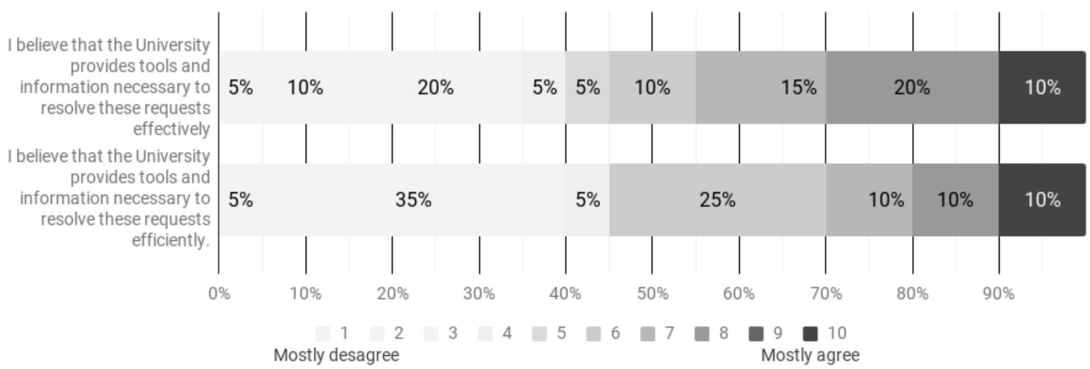

Figure 4-16. Perception of the support they receive from the university to perform the task.

5. **Importance of the university offering a support service in the application process (figure 4-17)**

- 85% of respondents strongly agree that it is important for the university to have a service to support the process of attending to and resolving applications for enrolment and withdrawal from courses.
- 55% of respondents strongly agree that it is important for the university to offer students a face-to-face support service in the application process.

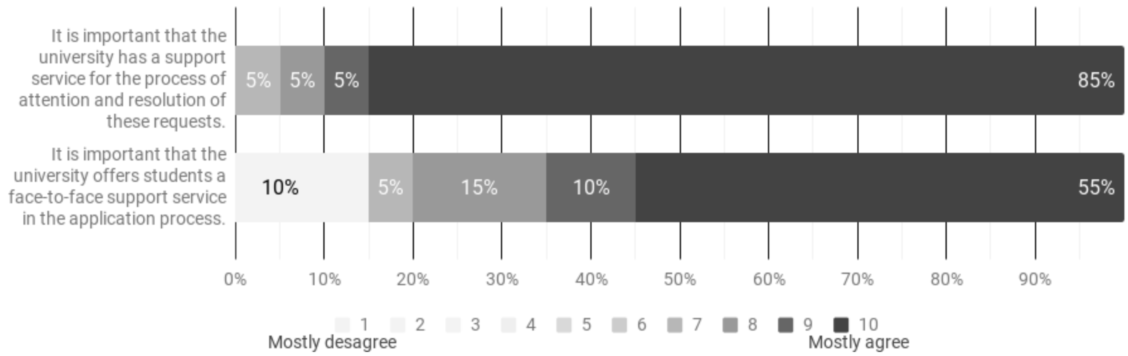

Figure 4-17. Importance of the university offering a support service in the application process.

6. Self-reported level of confidence with enrolment and withdrawal decisions (figure 4-18)

- 57.9% of those surveyed agree that they are generally satisfied with the decisions they make when deciding on special enrolment and withdrawal applications.
- 50% of respondents agree that they are confident that special enrolment and withdrawal requests are properly dealt with.

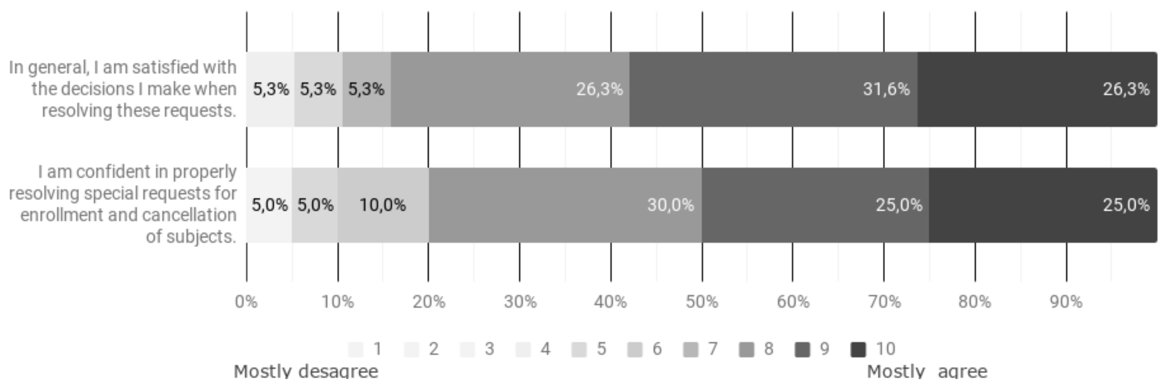

Figure 4-18**.** Self-reported level of confidence with enrolment and withdrawal decisions.

7. Perception of the importance of reviewing academic records and identifying relevant information

Through an open-ended question, opinions were collected on the importance of reviewing academic trajectories and relevant information in making decisions regarding enrolment and withdrawal applications.

Figure 4-19 shows that the vast majority of respondents (90%) say that it is important or very important to be able to access the academic record of the student who makes a special subject request in order to make a decision about it.

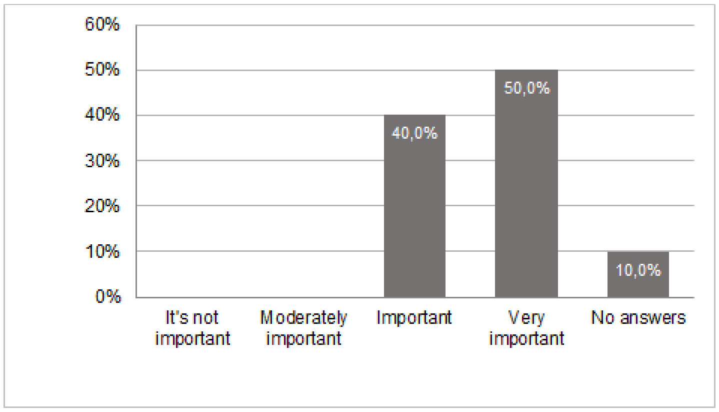

Figure 4-19. Importance of access to the student's academic record

School directors consider the following data to be the most relevant for decision-making:

- Curriculum development.
- Cumulative General Average (CGA) and Semester Weighted Average (SWA).
- Number of subjects passed per semester.
- Previous year's grades.
- Courses cancelled/failed (how many times).
- Subjects registered in the corresponding semester.
- Applications from previous years.
- Undergraduate resolutions.
- Fulfilment of pre-requisite subjects.

8. Number of students per school (potential impact)

This information was not collected from the surveys. The information is relevant because it shows the number of students potentially benefiting from the use of the tool. Based on the statistics published in the 2019 report, the number of students per degree programme involved in the pilot is detailed in Table 4-5. There are 5870 students who could potentially benefit from the pilot.

Faculty / Degree	**Total number of students potentially involved**
Design	81
Visual Arts	155
Geology	335
Chemistry and Pharmacy	403
Agronomy	513
Law	468
Civil Engineering in Informatics	304
Civil Engineering in Civil works	421
Acustic Civil Engineering	122
Naval Engineering	258
Bachellor in Engineering Science	88

Pedagogy in Communication of the English Language	207
Kinesiology	285
Occupational therapy	300
Nursing	314
Industrial Civil Engineering (Puerto Montt)	494
Commercial Engineering (Puerto Montt)	339
Information and Management control Engineering	257
Nursing (Puerto Montt)	291
Pedagogía en Educación Diferencial con Mención	235
TOTAL	5870

Table 4-5. Total number of students potentially involved by degree.

Phase 2: Agreements

Description of the pilot population

A total of 23 school directors signed the agreement document (see UACh Annex 3) to participate in the pilot project. Sixteen of them were from the Valdivia headquarters and seven from the Puerto Montt headquarters (see Table 4-6).

Rol	**Unit**	**Number**
Faculty Director	Design	1
Faculty Director	Geology	1
Faculty Director	Chemistry and Pharmacy	1
Faculty Director	Agronomy	1
Faculty Director	Electronics Civil Engineering	1
Faculty Director	Informatics Civil Engineering	1
Faculty Director	Civil Engineering in Civil works	1
Faculty Director	Building Engineering	1
Faculty Director	Pedagogy in Communication of the English Language	1
Faculty Director	Kinesiology	1
Faculty Director	Public administration	1
Faculty Director	Speech Therapy	1
Faculty Director	Industrial Civil Engineering	1
Faculty Director	Commercial Engineering	1
Faculty Director	Information and Management control Engineering	1
Faculty Director	Psicology	1
Faculty Director	Pedagogy in Differential Education with Pedagogy mention	1
Faculty Director	Bachellor in Engineering Science	1
Faculty Director	Naval Engineering	1
Faculty Director	Acustic Civil Engineering	1
Faculty Director	Occupational therapy	1
Faculty Director	Visual Arts	1
Faculty Director	Nursing	1
	Total	**23**
	Distribution by gender **Women 11 (47,8%)** **Men 12 (52,2%)**	

Table 4-6. Total number of Faculty directors by Unit which have signed the agreement.

Phase 3: Training

Description of the training phase

Three training workshops were held, each at the participants' headquarters. That is, two workshops at the Valdivia headquarters and the other at the Puerto Montt headquarters, with a duration of 3 hours each.

The objective of the workshops was to provide instruction that would allow school directors to understand how the TrAC tool supports decision-making processes and how TrAC facilitates feedback to students during their university life.

The workshops consisted of three activities detailed below:

Activity 1

- Response by the participants to the questionnaire on perception (See UACh Annex 2) of the process of attention to applications.
- Presentation of the TrAC tool.

Activity 2

- Presentation of real cases that exemplify how the TrAC tool can be used.
- Individual work by the participants that consisted of the resolution of one or two real requests, writing the sequence of steps when solving each one.
- Group discussion.

Activity 3

- Evaluation of the training through a satisfaction survey

Description of participants in the training phase

The workshops brought together a total of 20 school directors (11 women and 9 men) from the Valdivia and Puerto Montt sites. The first workshop was held on April 8th in Puerto Montt, the second workshop on April 9th in Valdivia, and the third workshop on August 10th in Valdivia, which we call session 1, session 2 and session 3, respectively.

The profile of the participants can be summarized through the following characteristics:

- The time spent in the role of school director. This characteristic varies among participants, where the shortest time in the role is only one month compared to the longest of nine years. Most of them have been in the role for less than three years.
- The age of the participants. Most participants are between 40 and 49 years old.
- Level of technology use. The participants state they possess a medium-high level of technology use. Tables 4-7, 4-8 and 4-9 detail the characteristics of the participants in sessions 1, 2 and 3, respectively.

Role	Unit	Time at this role	Age range	Gender	Level of technology use
Faculty Director	Nursing	9 months	40 to 44	Woman	Medium
Faculty Director	Industrial Civil Engineering	9 years	40 to 44	Woman	Medium
Faculty Director	Commercial Engineering	4 years	40 to 44	Woman	Medium
Faculty Director	Information and Management control Engineering	1 year and 6 months	35 to 39	Woman	High

Faculty Director	Pedagogy in Differential Education with Pedagogy mention	No information	No information	Woman	No information
Total: 5 Participants					
Distribution by gender **Women 5 (100%)** **Men 0 (0%)**					

Table 4-7. Summary of participants in session 1 of training

Role	**Unit**	**Time at this role**	**Age range**	**Gender**	**Level of technology use**
Faculty Director	Design	No information	No information	Man	No information
Faculty Director	Geology	No information	No information	Man	No information
Faculty Director	Chemistry and Pharmacy	10 months	45 to 49	Woman	Medium
Faculty Director	Agronomy	4 years	40 to 44	Woman	Medium
Faculty Director	Law	1 months	40 to 44	Man	Medium
Faculty Director	Civil Engineering in Informatics	3 years	45 to 49	Woman	High
Faculty Director	Civil Engineering in Civil works	1 year and 2 months	45 to 49	Man	High
Faculty Director	Pedagogy in Communication in English language	7 months	40 to 44	Woman	Medium
Total: 8 Participants					
Distribution by gender **Women 4 (50%)** **Men 4 (50%)**					

Table 4-8. Summary of participants in session 2 of training

Role	**Unit**	**Time at this role**	**Age range**	**Gender**	**Level of technology use**
Faculty Director	Naval Engineering	3 years	40 to 44	Man	High
Faculty Director	Kinesiology	No information	No information	Man	No information
Faculty Director	Nursing	3 years	45 to 49	Woman	Medium
Faculty Director	Bachelor’s in science engineering	1 month	60 to 64	Man	High
Faculty Director	Visual arts	1 month	40 to 44	Man	Medium
Faculty Director	Acustic Civil Engineering	3 years	50 to 54	Man	High
Faculty Director	Occupational Therapy	No information	No information	Woman	No information
Total: 8 Participants					
Distribution by gender **Women 2 (28,6%)** **Men 5 (71,4%)**					

Table 4-9. Summary of participants in session 3 of training

Evaluation of satisfaction of training phase participants

To ascertain each participant's assessment of the training, a satisfaction survey was carried out in an online format (see UACh Annex 4). In it, each participant had to select his or her level of satisfaction in relation to different aspects of the training. In addition, lessons learned from the workshop and suggestions for improvements to the tool were collected. This survey was answered at the end of the workshop.

The main results of the satisfaction survey (figure 4-20) are:

- 55.6% of the respondents had a positive perception of the workshop.
- 44.4% of the respondents had a positive appreciation of the format in which the workshop was held.
- 33.3% of respondents fully agreed that they felt confident about starting using the tool in the pilot, whereas 33.3% said they agreed somewhat with feeling confident.
- 44.4% of respondents fully agreed that they knew where to go or who to contact for problems or questions during the pilot.
- 55.6% of respondents fully agreed that they would recommend the training to another colleague.

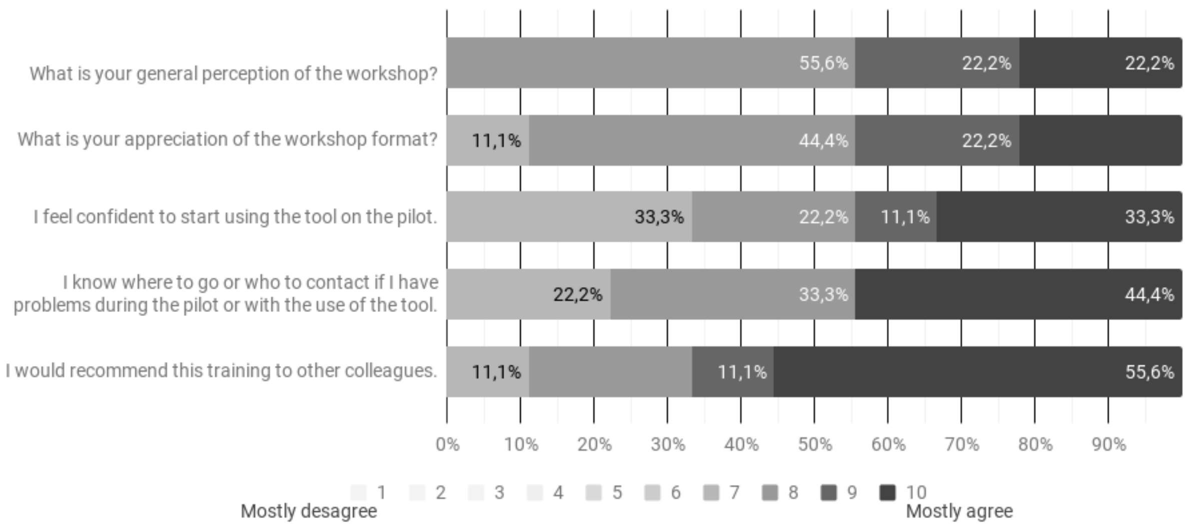

Figure 4-20. Training satisfaction survey results

Evaluation of learning achievement of training participants

To assess learning achievement, participants were asked to resolve actual requests regarding their programme (degree). As they resolved each request, they were asked to record the resolution process on a form (see UACh Annex 5).

For each request, the director had to record the level of complexity of the request (1: very simple, 10: very complex), then for each action performed, its type was recorded (A: Analysis, B: Search, D: Decision), description and level of satisfaction (1: not very satisfied, 10: very satisfied)

The following indicators were defined to describe whether the expected learning was achieved in the participants:

1. The participant is able to resolve any request.

2. The participant performs at least one action of each type.
3. The participant solves requests of different difficulty.

The results with respect to the indicators can be seen in *Table 4-10* and *Figure 4- 21.* The results show that the vast majority of participants who carried out the activity achieved the learning objectives, where Indicator 3 caused the most difficulty, as most participants solved low difficulty requests. Indicators without information are due to participants who were not able to participate in the entire workshop.

Faculty	**Indicator 1**	**Indicator 2**	**Indicator 3**	**General result**
Nursing	No information	No information	No information	**No information**
Industrial Civil Engineering	Achieved	Achieved	Not achieved	**Achieved**
Commercial Engineering	Achieved	Achieved	Not achieved	**Achieved**
Information and Management control Engineering	Achieved	Achieved	Partially achieved	**Achieved**
Pedagogy in Diferential Education	Achieved	Achieved	Not achieved	**Achieved**
Design	No information	No information	No information	**No information**
Geology	Achieved	Achieved	Not achieved	**Achieved**
Chemistry and Pharmacy	Achieved	Achieved	Achieved	**Achieved**
Agronomy	Achieved	Achieved	Not achieved	**Achieved**
Law	Achieved	Achieved	Not achieved	**Achieved**
Civil Engineering in Informatics	Achieved	Achieved	Partially achieved	**Achieved**
Civil Engineering in Civil works	Achieved	Achieved	Partially achieved	**Achieved**
Pedagogy in Communication in English language	No information	No information	No information	**No information**
Naval Engineering	Achieved	Achieved	Partially achieved	**Achieved**
Kinesiology	Achieved	Achieved	Achieved	**Achieved**
Nursing	Achieved	Achieved	Achieved	**Achieved**
Bachelor in Engineering Science	Achieved	Achieved	Achieved	**Achieved**
Visual Arts	Achieved	Achieved	Partially achieved	**Achieved**
Acustic Civil Engineering	No information	No information	No information	**No information**
Occupational Therapy	Achieved	Achieved	Partially achieved	**Achieved**

Table 4-10. Indicator results by degree

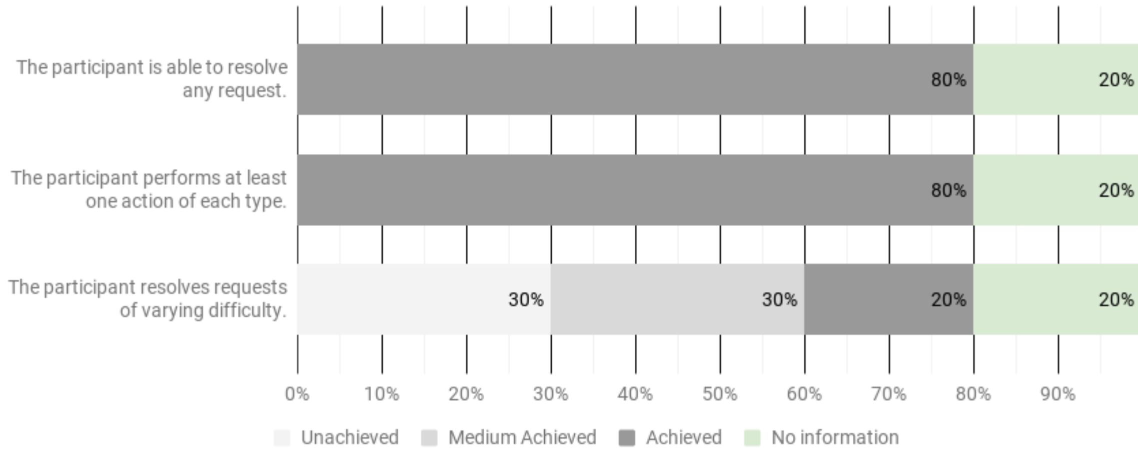

Figure 4-21. Results of learning achievement indicators by degree programme.

Phase 4: Use and Impact

Descriptive statistics of use records

The TrAC tool has a system that records the actions performed by users on it. The analysis of these registered actions, in the period from March to November 2019, shows that 22 users have used TrAC at least once. These users correspond to those who participated in the pilot from the beginning and to new users who joined after the training. Of the 22 users, 21 are school directors, and 1 user is the undergraduate director general (who requested access to TrAC to inspect cases within his competence). The 22 users have performed a total of 7007 actions (actions in the system other than logging in). These actions involve inspecting students, clicking on courses, etc. In total, users have inspected 464 different students (not all of them have participated in face-to-face sessions).

Figure 4-22 and Figure 4-23 show the distribution of the actions carried out by the users and students inspected, respectively. As can be seen, there are different intensities of use.

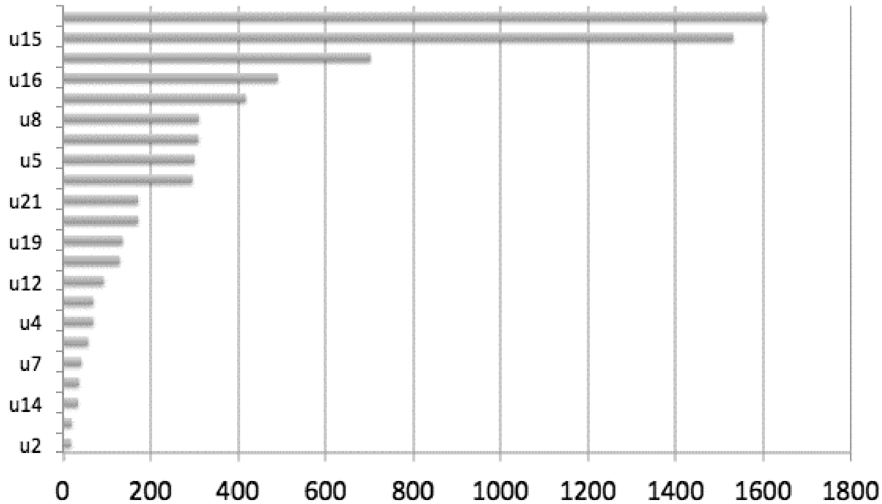

Figure 4-22. Number of actions by school directors

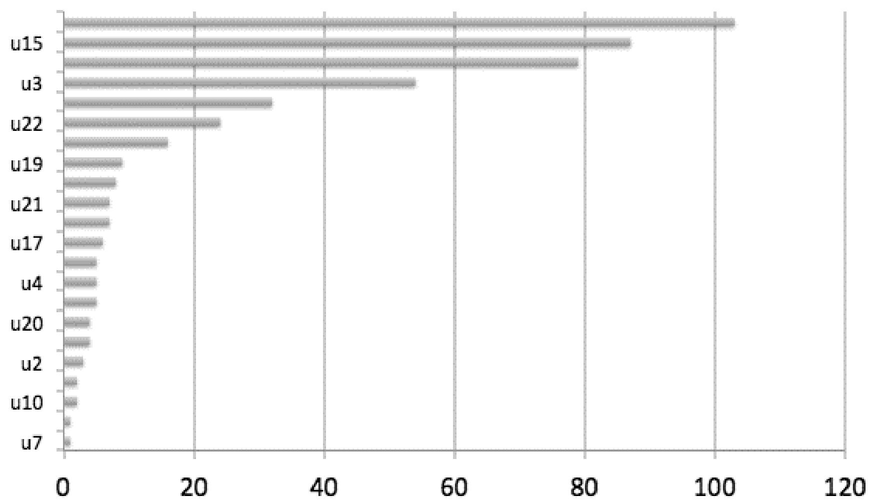

Figure 4-231**.** Number of students inspected per user.

TrAC use and utility survey

To collect information on the use or practices supported by the TrAC tool during the counselling process, each director was asked to use the tool during sessions where they receive students in person. It should be noted that these face-to-face sessions represent a subset of the directors' work with respect to the resolution of applications, the vast majority of which are resolved online. At the end of the face-to-face counselling sessions, both the director and the student involved answered a survey (See UACh Appendix 6). This survey consists of open and closed questions.

The surveys were delivered on 7 May 2019 to school principals at the Valdivia site and on 7 June, 2019 to school principals at the Puerto Montt site. The results of these surveys are discussed below.

Results of the survey on the use and utility of TrAC in face-to -face counselling

To obtain results, the records made by two school directors in 17 counselling sessions were analysed. In these face-to-face sessions, school directors interacted with 19 students who also recorded their views on the use of TrAC in the session. The answers to the open questions allow us to determine that:

- School directors have used TrAC in face-to-face counselling sessions and the vast majority positively assess all aspects evaluated in the survey. That is, attention to students using TrAC becomes more effective and efficient, as well as helping to communicate and understand the current situation and look at the future situation of the student.
- Likewise, students consider that the use of TrAC in face-to-face sessions supports the visualization of their academic situation by facilitating reflection on the past and present situation. It therefore facilitates decision-making. It is noteworthy that the vast majority of students would like to continue using TrAC and also have access to TrAC independently.

The results of the closed questions are shown in the following figures 4-24 and 4-25:

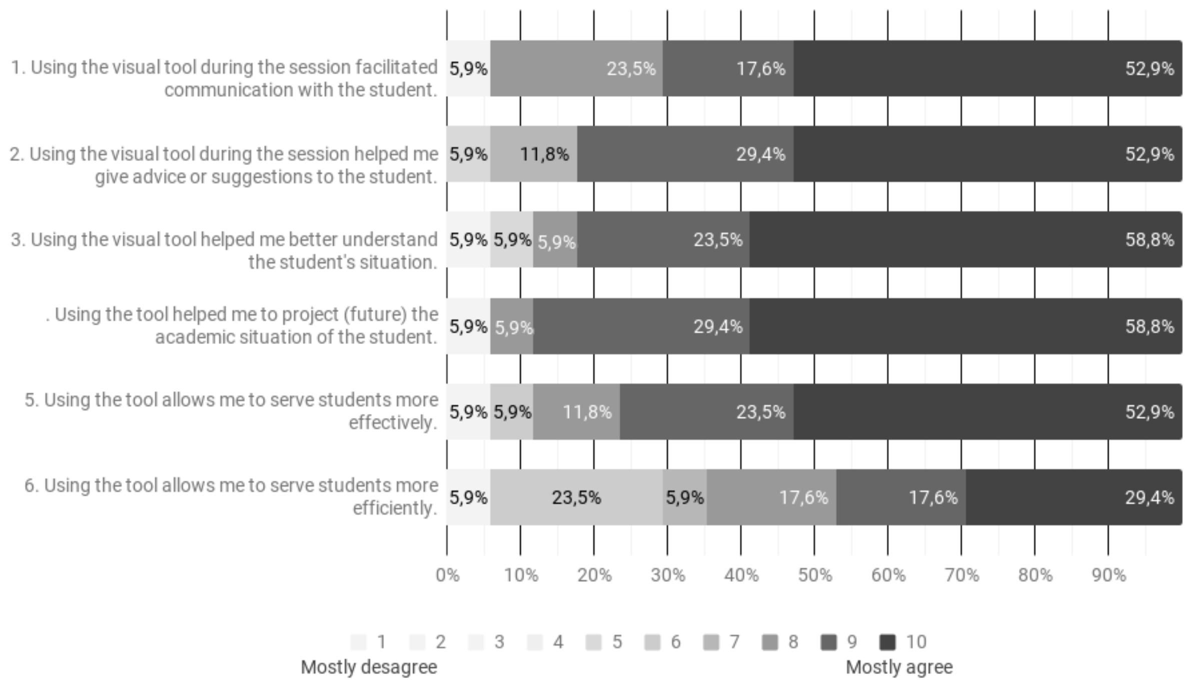

Figure 4-24. Results of a survey on the usefulness of TrAC in face-to-face counselling (counsellors).

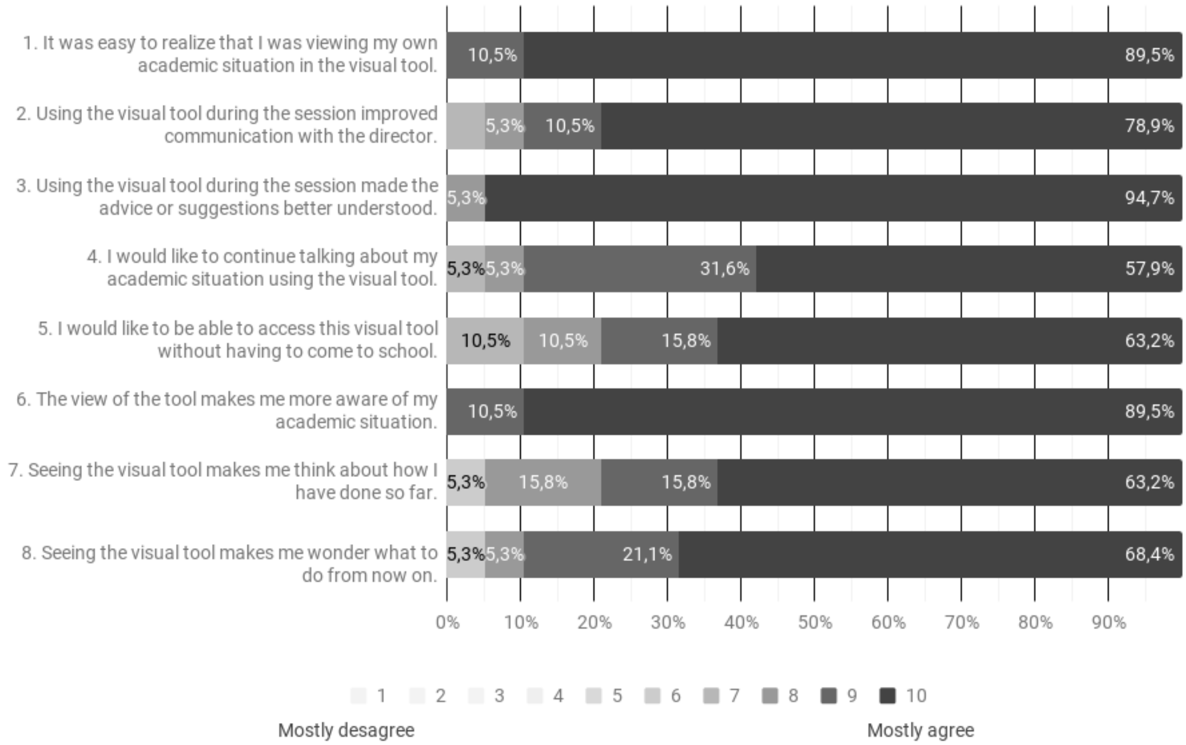

Figure 4-25. Results of a survey on the usefulness of TrAC in face-to-face counselling (students)

Impact on student performance results

To evaluate whether the pilot has positively influenced student performance, the change in position of the students involved in the 2018 versus 2019 ranking was analysed. The choice of measuring performance according to the cohort ranking was made to mitigate the effects of unexpected events in a semester, as all students in the cohort are exposed to these events. It also enabled evaluation of the performance of each student before and after the incorporation of the tool.

The analysis of the 352 students involved during the first semester 2019 demonstrated that 200 of them (57%) showed an improvement in their performance in the following semester. This improvement is shown by the fact that the students included held a better place in the ranking with respect to their cohort. More specifically, they improved 9.8 positions on average. Figure 4-26 shows the distribution of this difference.

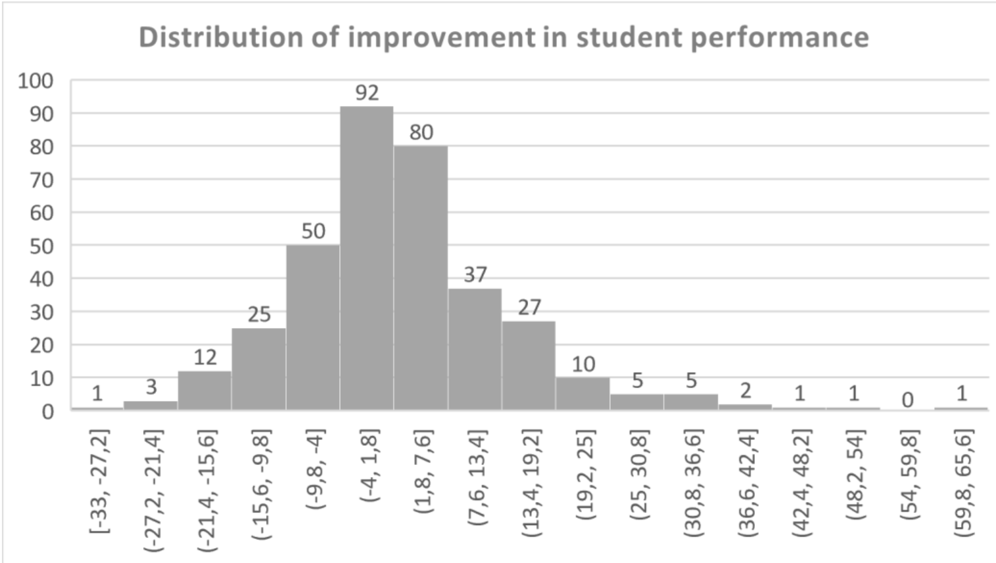

Figure 4-26. Impact on student performance

While these results are inconclusive because isolating the effect of one counselling tool from the other events that affect a student's performance is very difficult, it provides a basis for future, more detailed analysis.

Phase 5: Evaluation and Improvement

Description of evaluation and improvement

After training and making the tool available for use, an assessment was made of whether participants perceive an improvement in the application resolution process. This improvement is measured in terms of time, confidence in decisions and the perception of support in this work. Based on this assessment, an analysis was made of possible improvements and adaptations to be made to use TrAC in other institutions.

The activities and results of this evaluation are discussed below, and as will be seen below, they show a positive impact that meets the expectations for the tool and for the pilot project.

Socialization and evaluation activity

Two socialization and evaluation sessions were held with school directors, one on 7 May at the Valdivia site and the other on 7 June at the Puerto Montt site, each lasting one and a half hours. The workshops were held during the course withdrawal process. The objective of these sessions was to provide a space for school directors to socialize about the use of the TrAC tool and its integration into their activities. Through this activity it was possible to evaluate the usefulness and impact of TrAC and also the relevance of the process followed during the pilot.
The workshops were divided as follows:
<u>Activity 1</u>

- Responding to a questionnaire on the perception of the usefulness and impact of the TrAC tool and the perception of the piloting process (see UACh Annex 7).

- Presentation of the new features of the TrAC tool.

Activity 2

- Guided group discussion.

Activity 3

- Delivery of surveys for face-to-face counselling (discussed above in the Use Phase).

A total of 11 school directors from the faculties and degrees detailed in Table *4-11*.

Faculty	**Number**
Faculty of Science Engineering	2
Faculty of Philosophy and Humanity	1
Faculty of Sciences	2
Faculty of Architecture and Arts	1
Faculty of Law and Social Sciences	1
Commercial Engineering	1
Industrial Civil Engineering	1
Information and Management control Engineering	1
Nursing	1
Total	**11**
Distribution by gender **Women 7 (64%)** **Men 4 (36%)**	

Table 4-11. Involved degrees in the activity.

TrAC utility results

Regarding the use of the tool, the directors say that while for them it does not change the process they follow when resolving an application, TrAC has helped them to optimize the time spent on resolution as it allows them to visualize a lot of information more easily. Also, the tool helps them to reduce errors during resolution thanks to the easy access to the information they need, several mention that with the current system they must access different sections to obtain the necessary information.

Figure 4-27 illustrates the results obtained in the questions concerning the usefulness of using TrAC. The results show that:

- Most participants consider that after the incorporation of TrAC the decision-making process for resolving applications has not changed.
- Most participants consider that the use of TrAC has provided access to more information for deciding on applications.
- Most participants fully agree that using TrAC helps to make better decisions about applications.
- Most participants feel that using TrAC helps to better explain their application decisions.
- Most participants say they would like to continue using TrAC if the tool is available.

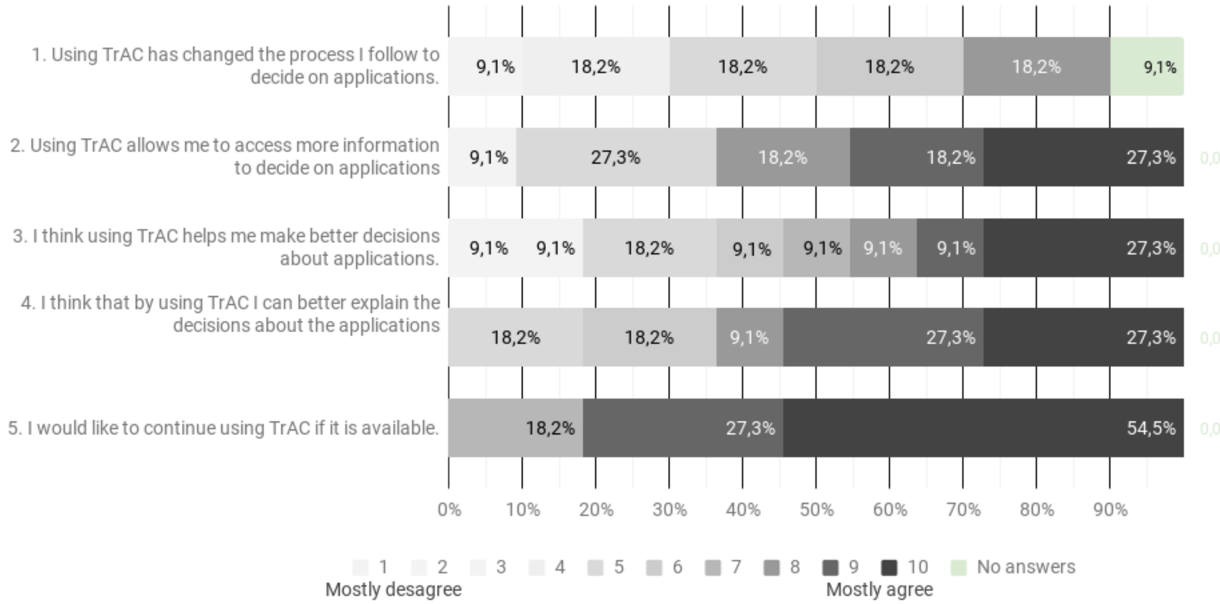

Figure 4-27. Usefulness results on the use of TrAC.

Results related to impact (decision-making) of TrAC

TrAC has allowed school directors to visualize problems in the structure of the curriculum. For example: in the case of end-of-studies subjects that require having fulfilled all the previous requirements, when looking at the grid in its entirety, you can see that these subjects have not taken that into consideration, thus identifying errors with the curriculum.
Several directors mention the importance of students accessing the tool in order to improve their own decisions when requesting their subjects and to advance in their degree programme, to plan more effectively.

Figure 4- 28 illustrates the results obtained in the questions concerning the impact produced by the use of TrAC. The results show that:

- On average, most participants felt that TrAC allowed them to visualize 'bottleneck' subjects on the curriculum (question 1 in the graph).
- Most participants stated that TrAC has enabled them to generate new ideas for curriculum improvements (question 2 in Figure 4- 15).
- On average, TrAC has changed directors' perceptions of students' academic progress trajectories (question 3 in the graph).
- Most participants agree that using TrAC has made them think about possible changes in the pre-requisite subject structure (question 4 in the graph).

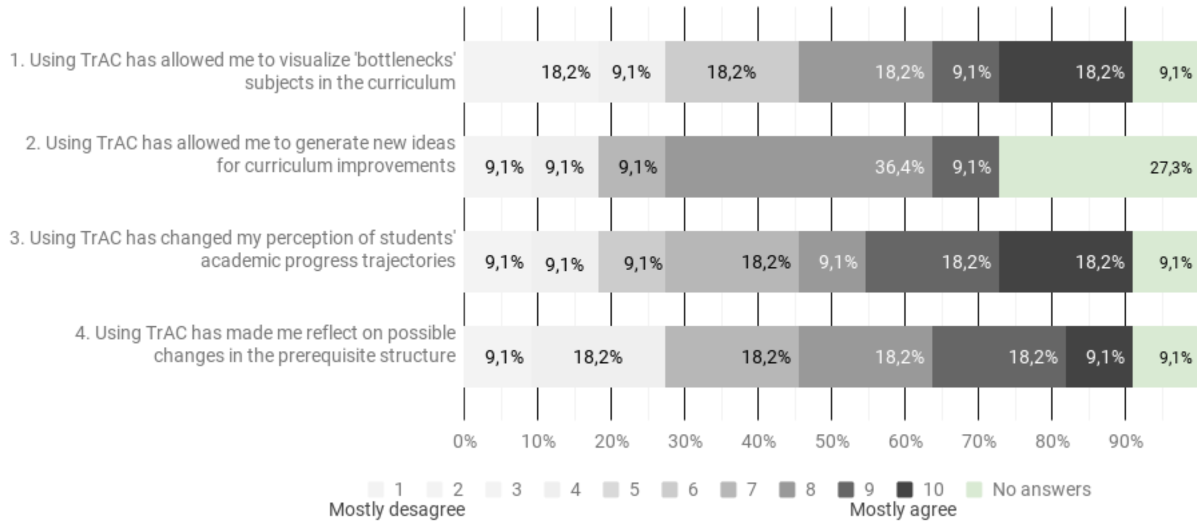

Figure 4-28. Results of the impact of the use of TrAC.

Results of the pilot process perception

In general, the activities carried out during the pilot process have been evaluated very positively by the participants, as most of them rate them as "Very relevant" (see Figure 4-29).

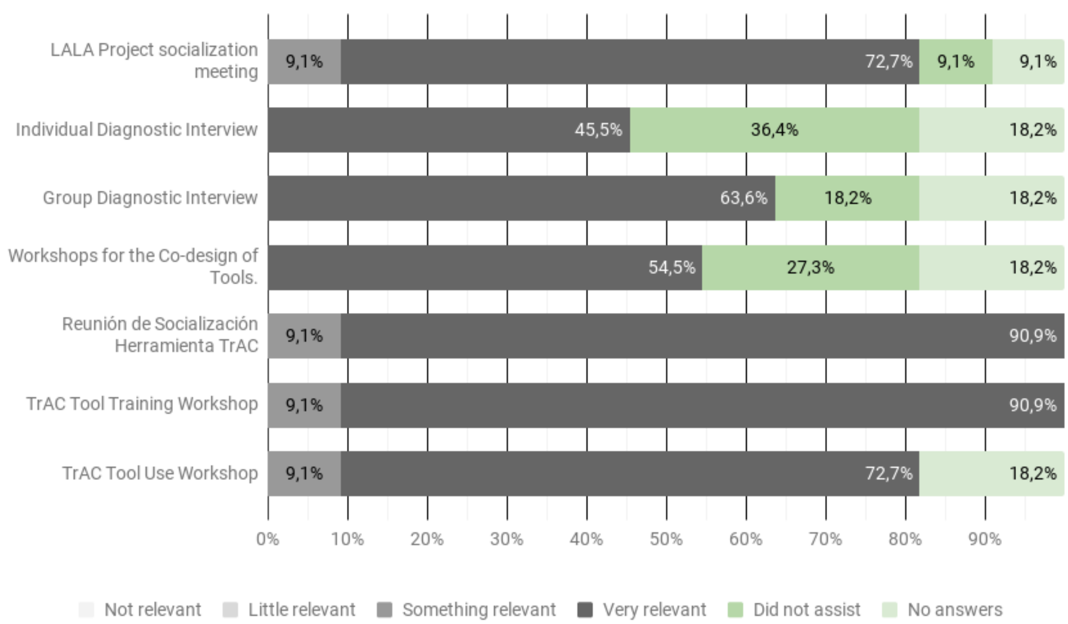

Figure 4-29. Results of the relevance of the piloting process.

Summary of improvement proposals

During the socialization activities with the school directors, proposals for improvement in the visualization of the tool were detected. The improvements that were addressed during the piloting process are listed below.

- Improved requirements display including subjects that have the currently selected subject as a requirement
- Highlights of subjects the student is currently taking
- Treatment of equivalent subjects
- Show eliminations
- The 4.0 threshold and the AGA of the degree programme were incorporated into the student's trajectory
- Users with multiple programmes
- Student version tool
- Case of mentions (in process)

The following is a list of improvements that have not been addressed during the pilot and will be addressed in future work:

- Median on histograms
- Integration with the schools' administrative system
- Display of e-mail, name, and photo of the student
- Cohort Views
- Organization of the curriculum by disciplinary areas and specialization
- Allow dashboard to be exported to PDF

During the pilot, improvement possibilities were detected that impact the ease of operation and administration of the tool. The following is a list of improvements that have been addressed during the pilot:

- Creating a user administration module
- Code refactoring for automatic detection of using the anonymization service
- Improved error handling while maintaining safety
- Incorporation of continuous integration practices

Closing and evaluation activity

Two closing and evaluation sessions were held with school directors, one on October 4 at the Puerto Montt headquarters and the other on November 27 at the Valdivia headquarters, each lasting one and a half hours. The aim of these sessions was to provide a space for school principals to reflect on the use of the TrAC tool and integration into their activities. Through this activity it was possible to evaluate the usefulness and impact of TrAC as well as the usability of the tool.

The workshops were divided as follows:

- Guided group discussion
- Development of a questionnaire on the perception of utility, impact, and usability of the TrAC tool (see UACh Annex 8).

A total of 8 school directors from the faculties and degree programmes detailed in *Table 4-12*

Faculty	Number
Faculty of Science Engineering	3
Faculty of Sciences	1
Faculty of Law and Social Sciences	1
Commercial Engineering, Puerto Montt	1
Information and Management control Engineering	1
Nursing, Puerto Montt	1
Total	**8**
Distribution by gender **Women 5 (64%)** **Men 3 (36%)**	

Table 4-12. Degrees involved in the activity.

Closing survey results

The System Usability Scale (SUS) results average 76.9, which is considered good. The distribution of the score is shown in the *Figure 4- 30*.

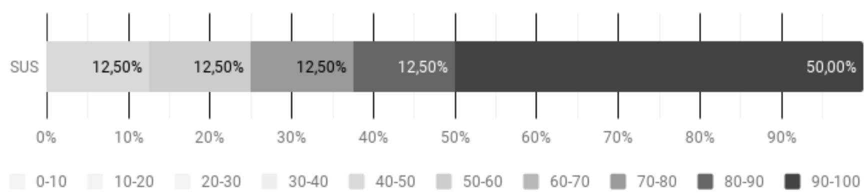

Figure 4-30. Distribution of SUS score in TrAC tool

The results on the impact and usefulness of the tool are shown in Figures 4-31, 4-32 and 4-33, corresponding to the resolution of applications for special subject enrolment, subject withdrawal, and counselling sessions, respectively.

The results show a positive evaluation of the tool, especially because it promotes more efficient and effective work and provides means to a better explanation of decisions.

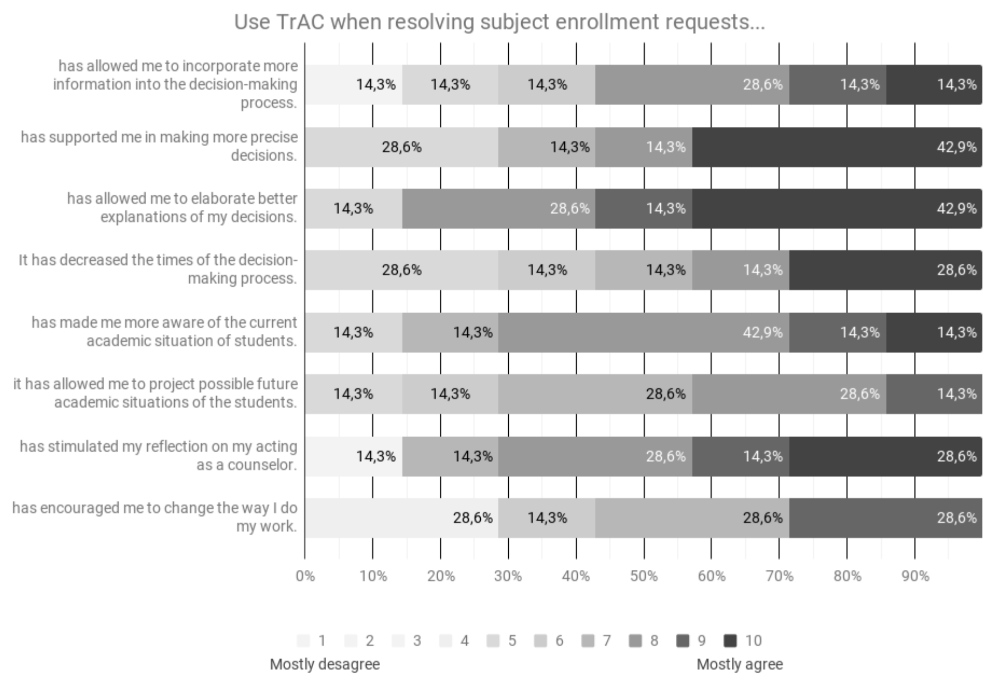

Figure 4-31. Perception of impact and usefulness of TrAC in the resolution of special applications for the enrolment of subjects

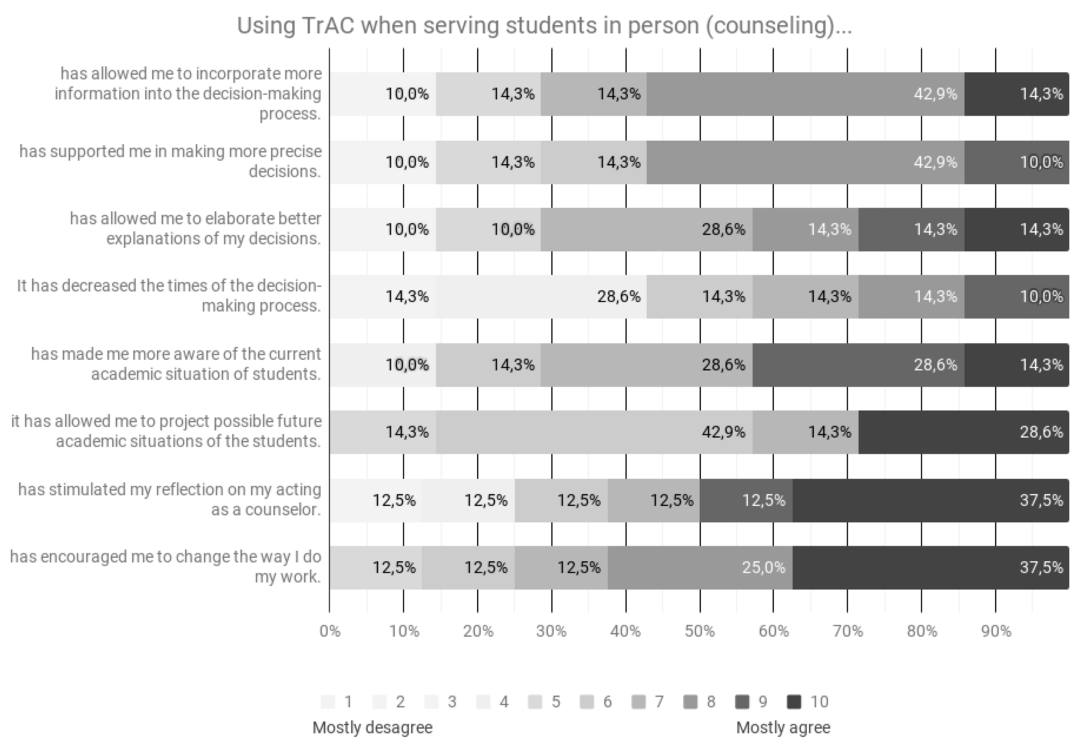

Figure 4-32. Perception of impact and usefulness of TrAC in the resolution of special requests for withdrawal from courses

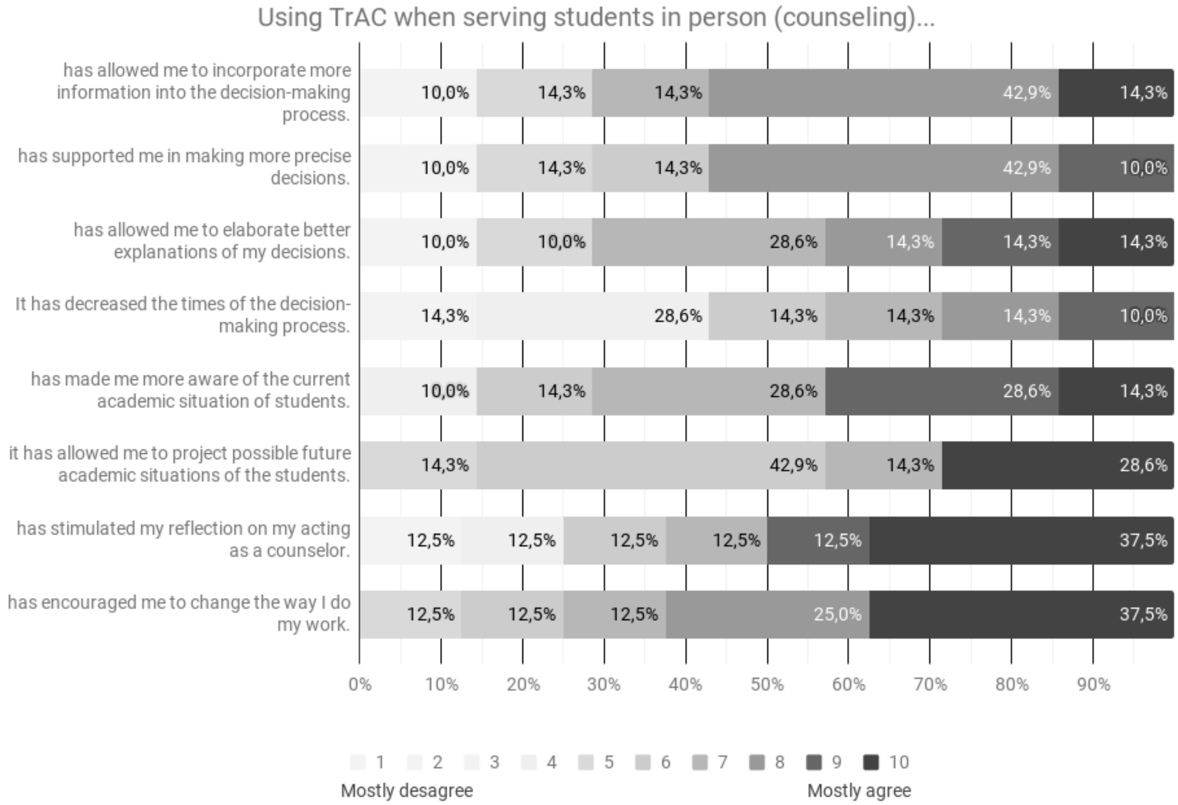

Figure 4-33. Perception of impact and usefulness of TrAC in face-to-face counselling sessions

Post-pilot analysis results

This section presents the **list of lessons learned** from the pilot conducted. This list is intended to guide other institutions in their piloting process when adopting TrAC or another LA solution.

For an organization to implement an LA pilot requires a **multifunctional team** to lead the initiative. This team should oversee defining the pilot plan and coordinating the relationship with the rest of the stakeholders. This team should be responsible for the following tasks: (1) planning of the pilot and the ethical management needed to carry out the activities; (2) preparation of the contents to be disseminated during the pilot, such as presentations of the tool, manuals, and an invitation to participants; (3) coordination of the pilot from planning to execution, data collection and analysis.

It is necessary to have **technical staff** as part of the team. They should oversee updating the data related to the programmes (degrees) in which the pilot is going to be held and of verifying that the data shown in the tool reflects reality. In addition, they must periodically analyse the tool use data. This is of great importance to take remedial action if users are not actively participating.

Define **data exchange protocols**. In the case of the UACh there is no protocol for exchanging data with non-institutional tools. Therefore, an early definition of this protocol and concrete data exchange allows the tools to be more useful and their real relevance to be evaluated.

Communication of concrete results is vital to the success of an LA pilot, so a data analyst should be responsible for collecting and analysing the logfiles collected, as well as processing the data collected in surveys and group discussions. From these data, analytical reports should be generated to be shared and disseminated with the participants of the pilot, and with the leaders of the institution. The communication of the activities carried out and the results of the pilot are very relevant evidence when it comes to ensuring sustainability.

In addition to the lessons learned, we have identified **some aspects of improvement for the planning of** future **pilots**:

- The activities defined in the pilot must be complemented by intensive dissemination activities. And a manager must be defined for this activity.
- The tools should be socialized early with the authorities of the institution. To detect possible conflicts with the institution's security and ethical policies.
- Socialize the tools with other users, even if they are not specifically designed for them. In the case of TrAC it was found that with minimal modifications the tool could be used by students.
- Detailed planning at the beginning of the pilot should be considered useful to guide the process. However, social mobilizations (particularly frequent in the Latin American context) have a wide participation of university students. This is why academic calendars are likely to be affected and, with them, the key activities for piloting and availability of those involved.
- The data used by the tools as well as the results of the algorithms must be analysed in detail before being shared with the end users. Because data errors can undermine the trust built by the team.

4.3.1.2 TrAC Prediction Tool Pilot Project

The prediction extension to the counseling tool in TrAC (Academic and Curricular Path) allows school directors (program directors) to preventively attend to possible students at student risk, considering this model a complement to the visualization of information academic award granted by TrAC. Consequently, TrAC is an integration of visualization and prediction of academic trajectories to support the counseling of principals.

The main objective of the extension is to proactively support school directors in making decisions regarding the detection and monitoring of students who are at risk of dropping out, mainly at the beginning of the semester, based on the possibility of visualization, in an integrated way, of the structure of the curriculum of each student (courses, semesters, required courses), the performance of students in courses (grades, cancellations, repetitions) and the risk indicators that extend the visualization.

Resources

The resources used for the execution of the pilot project were as follows:

- Server to host the tool
- Computer technician for service support (tool availability)
- Project researchers for data collection and analysis
- Pilot Team
    - **Project Coordinator**
    - **Specialists in technological infrastructure**

   - **Group for training, pilot project support and monitoring**
   - **Administrative Assistant**
- Participants. The target audiences to be reached within the university are:
  End users: directors of schools of the Faculty of Engineering Sciences and of the degree programmes in English Pedagogy, Nursing, Chemistry and Pharmacy, Medical Technology, Occupational Therapy and Veterinary Medicine.
  Managers: Dean's team of the Faculty of Engineering Sciences, Director of Undergraduate Studies, Director of Institutional Analysis and Accreditation Officer.
  Others Involved: Directorate of Information Technology and Head of Computer Science at the Institute of Computer Science.

Planning

Table 4-13 presents the phases, activities, dates, methodologies, efforts, and artefacts planned for the execution of the pilot project. During the execution of the project, these phases were adapted to various emerging situations, such as the rescheduling of academic activities following student strikes.

Phase	Activity	Start date	Termination date	Methodology
Preparation	Artefact development		25/06/2020	Development of artefacts such as presentations, email support.
	Socialization of the pilot plan with stakeholders		02/07/2020	Socialization Conference (directors of the schools of Engineering)
	Training of pilot programme staff	25/06/2020	01/07/2020	Pilot staff training workshop
Agreement	Agreement with the participants		02/07/2020	Project meeting
Training	Training for users	09/07/2020	25/07/2020	Training workshop for users (school directors who signed agreement)
Use	Accompanying users	09/07/2020	25/07/2020	Remote support
	Socialization of experiences		25/07/2020	Workshop of socialization of experiences
	Evaluation		25/07/2020	Partial evaluation workshop
Evaluation and Improvement (includes internal work)	General evaluation	08/2020	10/2020	Evaluation study
	Documentation of improvements	10/2020	11/2020	Documentation of improvements

Table 4-13. TrAC prediction pilot planning

A description follows of the development and results obtained after carrying out each of the activities in the phases mentioned in Table 4-13.

Phase 1: Preparation

Processes included in the pilot project

During the piloting, the decision-making process of detection and monitoring of students at risk of dropping out was intervened. This process does not currently have a support system for decision-making, but users have already used the TrAC (Academic and Curricular Path) tool as a platform for viewing and evaluating students' paths during academic application processes.

Current situation of the processes to intervene

Information was collected that evidences the situation that school directors currently face in terms of the tasks related to the processes of detection and monitoring of students at student risk (baseline). The information collected has served to characterize the relevance and impact produced by the incorporation of the prediction model in the TrAC tool.

Baseline of utility and impact

To obtain the baseline, a survey (see UACh Annex 8) and a semi-structured interview (see UACh Annex 9) were conducted with the participating School Directors. These instruments are intended to identify and characterize the process intervened from the experience of school directors and current regulations. Below are some of the findings identified from the sessions with the school principals.

The **results of the survey** show that the information available in the current management system of the UACh to identify students at risk of being a student is complete, relevant, and accessible (8.3 out of 10). However, there is no consensus regarding aspects such as the timeliness of the information and the ease and speed with which it can be accessed. For its part, TrAC counselling is evaluated positively (8.8 out of 10) in aspects such as relevance, accessibility, ease and speed. In summary, TrAC complements the current management system of the UACh, since it is better evaluated in those weak aspects of the management system.

These results show that there is room for improvement in both systems, as far as this project is concerned, the improvement should focus both on addressing those aspects in which TrAC has been evaluated negatively, but also improve even more in the aspects evaluated positively.

During the semi-structured interviews, the school directors describe the process of identifying students at risk of dropping out as reactive. For example, one of them mentions, when faced with the task of identifying students at risk, that “it is more reactive. The boys come to ask, or to request something, and there I look at them”. While the other participant indicates that "you show me ten students and tell me, let's see which of these is going to have a possible dropout, I don't know that." Likewise, the tools available to principals to determine possible students at risk of dropping out correspond to request instances, where principals observe the academic trajectories of students to make decisions. Thus, one of the directors mentions “the requests make me see [the trajectories of] a large number of students who have complications entering their subjects, and there, I do an analysis of why and talk with them, the requests tell me [problems]”. Which shows how reactive the identification process is. In the same way, the other director mentions that "I, only, based on the hard data that I have in the system, could infer which person is going to be able to cancel a semester or could gather all the academic part", reaffirming the reactive characteristic of the process, as well as the heterogeneity of actions that contribute to the identification of students at risk.

On the other hand, the criteria used to identify possible students at risk appear to be diverse and heterogeneous among participating principals. However, it seems that social and emotional factors have a strong presence in the decisions of students when leaving the race. In other words, one of the directors describes the difficulties of the students regarding learning strategies as “Good students who have sent me a semester suspension because they have not been able to get used to remote study and self-study online for the issue of COVID-19. As long as there is COVID-19, I am going to suspend my studies and good students, with a good development in their career, with semesters with good averages. How do I tell you something very personal ", while the other director mentions that the emotional can be influenced by academics, mentioning that" for me it is a mixture of ... emotional or psychological issues, pressures and academic performance, and that academic performance may be mainly related to mathematics, physics, and basic sciences, which are not prepared.”

Likewise, the directors have indications about what could be the main causes of academic dropouts, due to their trajectory in office. Shortcomings are recognized in academic preparation before entering university, as indicated by one of the directors saying that "they do not come prepared and you have to take care of all that ... and that falls back, it weighs on the boys." Furthermore, patterns are identified in the academic trajectory, which is analysed when students make requests to school principals. This is evident in the director's comment, where he indicates that he recognizes a student in difficulty when “this person first had PGA (accumulated general average) 4, then it dropped to 3.2 and then to 3.9. I also check the amount of cancellation of bouquets. The first semester did not cancel anything, then it began to cancel in the following semesters "or from the other director, who indicates that" one of the things that is a bad symptom is when the student begins to throw out bouquets, some begin to appear in the subjects”.

In any case, the initial evidence shows that the process is based on the observation of the academic trajectory, analysing key indicators that require attention. However, the process continues to be reactive, responding to student requests and, perhaps, at times that may be late to provide support or follow-up to those in difficult and even critical situations.

To follow up on students who have or could have academic difficulties, there is also no consensus on the approach based on specific activities or strategies. Rather, the initiatives arise from the experience of the directors, the management tools available and the context of the school. Thus, for example, one of the directors bases his strategy on building community and trust, indicating that to address the accompaniment of students he relies on “conversations, conversations in the room, in corridors, some in the office, if it is already something, he's seriously turning his head, ehhhh to the office. So, but it is, mainly, because I have taught them, and for a matter of face observation”. While the other director bases his strategy on those students who come to the school for support in academic management, indicating that "[students] who communicate a lot, talk a lot, are people who find it difficult."

The process of detecting and monitoring students at academic risk of dropping out requires a considerable effort, since it is necessary to explore institutional data sources where it is necessary to do “a lot of click, the information is very dispersed in the same system on many screens”, which obfuscates and reduces the quality of the information. Or it is necessary to maintain close contact with the students, considering that “data management is that, in itself, having contact with students takes time” and that the director mentions that he must “enter the student's routine or the I search for their surnames. I click on the subjects taken. Seeing how this person entered such a year, for example 2016, I begin to see the degree of advancement in the career, and I see that he is not making much progress”.

Therefore, the academic management system presents deficiencies in the quality of the information and its usability, complicating not only the process under study but also others associated with school management.

Phase 2: Agreements

Description of the pilot population

The two school directors who participated in this pilot have signed the agreement document (see UACh Annex 3) to participate in the pilots of the LALA project. However, as the sessions were recorded, they were asked verbally for permission to record.

Both participants belong to the Faculty of Engineering Sciences, at the Valdivia campus of the University (see Table 4-14).

Role	Unity	Number
Faculty Director	Civil Engineering in Computer Science	1
Faculty Director	Civil Engineering in Civil Works	1
	Total	2
	Distribution by gender **Female 1 (50%)** **Male 1 (50%)**	

Table 4-14. Number of Faculty Directors per Unit who have signed an agreement.

Phase 3: Training

Description of the Training Phase

A training session was held with each director independently. That is, each director received the credentials of the version of the tool that had the prediction extension and that they could explore, autonomously, during a week before the training session. This session lasted approximately 1 hour, where the participants had to make use of the new predictive functionalities of the tool to detect, visually analyze and monitor the academic trajectory of students at risk of dropping out.

Phase 4: Use and Impact

Descriptive statistics of use records

The TrAC tool has a system that records the actions that users perform on it. The analysis of these registered actions, in the period from July to October 2020, shows that both participants used TrAC at least once. It is important to note that these users have participated in the piloting of the tool from the beginning, so they know the functionalities of visualizing academic trajectories and the different options for their analysis. Users have performed a total of 352 actions (actions in the system other than entering the system). These actions involve inspecting students, clicking on courses, etc. In total, users have inspected 14 different students.

TrAC Risk Use and Utility Survey

To collect information on the use or practices supported with the TrAC Risk tool during the counselling process, each principal was asked to use the tool to identify and follow up on students at risk of dropping out. Notably, these sessions represent a subset of the directors' work. At the end of the sessions, the participating directors answered a survey (See UACh Annex 10) and participated in a semi-structured interview (see UACh Annex 11). The purpose of both instruments was to evaluate the quality of the information presented by the tool in the intervened process and their perceptions about its usefulness in the risk detection process.

The **results obtained in the survey** reveal that the incorporation of TrAC Risk did not alter the frequency of use of the tool when addressing the academic processes carried out by school directors. Likewise, the results regarding the relevant, accessible, easy and quick access to information to identify students at risk remained positive (9 out of 10) compared to the initial evaluation of TrAC counselling. The greatest improvement in the results is observed in the timeliness and completeness of the information offered by TrAC Riesgo. This represents a substantial improvement over TrAC counseling.

In summary, the evaluation of the use of risk TrAC shows that it is a more useful and usable tool than the current management system of the UACh in all the aspects evaluated and also presents an improvement compared to TrAC counselling.

From the **semi-structured interviews**, it was determined that, with the incorporation of the risk model extension in TrAC, the principals naturally recognized the criteria associated with the student's risk of dropping out. For example, they combine risk variables that are present in tab a of TrAC, indicating that “for example, I would start looking at them with the highest risk percentile. And, what catches my attention, for me is a decisive factor, the fact that students have low progress in relation to the year of entry "or that" this one entered recently and has been short "or that" 90% abandonment 'yes poh, he's been fed up and he's made little progress”. Therefore, the tab presented variables that made sense to the directors in relation to the process of detecting students at risk.

Likewise, it is observed that the directors follow a similar pattern of analysis, that is, they first select the risk and progress criteria to then validate the indicators with respect to their academic trajectory and, finally, extract common patterns of academic behaviour. This is evidenced by the fact that, when selecting a student who, according to the principal, was at high risk, identifies that "he is doing almost pure end-of-basic science subjects ... that is, he is playing everything for everything" or “Here is one thing, in my personal experience as a school principal it is a field that costs them a lot. Graphic Methods for Engineering, mmm, this is a kind of [complicated] field for students "or" he has had difficulties, but not all of them in ... no, I think this person can advance, if he passes this semester. " Therefore, the extension not only allows identifying possible students at risk of dropping out, but also provides evidence of academic trajectories that probably lead to dropping out and, therefore, provides rich information for decision-making and academic advising. to the students. This is recognized by the directors, who indicate that “I think yes [I would accompany him], because he is in a critical situation this semester, he is playing it, and I would like to know if he is doing well at the moment or is he going wrong, maybe before ... [it fails] ". On the other hand, one of the directors mentions “I could keep looking at this question all the time”, which could be associated with the ease of use for the analysis. However, there are also spaces for improvement, such as the transparency of the algorithmic decisions behind the prediction model, as one of the directors mentioned in his comment “I don't know if they take this into account in their model”, as well as well as the ability to update the model to changes in the trajectories of each student, since “these things [academic performance], of course, remain as a precedent, but that perhaps does not mean that the behaviour continues to occur in the student , that they do not change, it will not necessarily go badly afterwards ”.

Consequently, it is observed in the comments of the participants a standardization of the process of detection and monitoring of students at risk motivated by the extension of TrAC, as well as support for decisions and counseling from the visualization of patterns in the trajectories of students with different levels of academic risk. However, it is necessary to consider future improvements in terms of transparency and updating of the prediction model, both to increase the confidence of career directors and not to overestimate the risk of students who have improved their academic performance.

Phase 5: Evaluation and Improvement

Description of Evaluation and Improvement

After the training and after making the tool available for use, it has been evaluated whether the participants perceive an improvement in the quality of the information regarding the process of identifying and monitoring students at student risk. This improvement is measured in terms of availability, use and confidence on the information presented to support the decisions associated with the intervened process. Based on this evaluation, an analysis of the possible improvements and possible adjustments to use TrAC Risk was carried out. The evaluation follows a mixed process based on a semi-structured interview and a questionnaire, from which we have been able to triangulate the perceptions of the directors about the impact of the tool.

Results Related to the Utility of TrAC Risk

Regarding the use of the tool, the directors recognize the value of the predictive extension incorporated in TrAC regarding the support of the decisions associated with the process of identification and monitoring of students at student risk. TrAC has contributed to the improvement in the time invested in the identification of students, since it allows them to recognize and validate students who could be at risk, verifying the proposal of the model through the visualization of the academic trajectory. Likewise, the tool allows them to recognize and validate critical trajectories of the curriculum in relation to student stagnation and, with this, identify student profiles based on their risk trajectories. In addition, managers mention that, with the current system, they must access different sections to obtain the information and, even then, they cannot collect all the information proactively.

Results Related to the Impact (decision making) of TrAC Risk

TrAC has enabled school principals to visualize critical points in the curriculum that contribute to academic dropouts and therefore put student continuity at risk. For example: students who tend to take risks with a greater number of subjects taken each semester or students who have difficulties with a particular type of content.

Results of the Perception of the Piloting Process

In general, the activities carried out during the piloting process have been evaluated by the participants in a very positive way, highlighting the proactivity of the model towards the identification and monitoring of students at risk, as well as the appropriate integration with the visualization of their trajectories as a mechanism to verify the proposed risk and to sustain corrective actions at the institutional and individual level.

Summary of Improvement Proposals

During the work sessions with the school directors, proposals for improvement in the visualization of the tool were detected. Below are the improvements that have not been addressed during piloting and that will be addressed in future work:

- The list of students may be prioritized, due to a combination of factors. For example: absences, a long time in the race and little progress
- Determine analysis patterns of students from the interaction of school directors.
- Establish a parameterizable interface of academic dropout risk criteria.
- Integrate academic information generated during the semester to the analysis models.
- Integrate non-academic information as parameters of the analysis model.

On the other hand, during the piloting possibilities for improvement were detected that impact the ease of operation and administration of the tool. Below is a list of the improvements that have been addressed during the piloting:

- Provide greater transparency of the prediction model in the tool.
- Provide the ability to update the prediction model in the tool based on changes in the academic trajectories of students.

4.3.2 Pilot Projects at Pontificia Universidad Católica de Chile (PUC-Chile)

4.3.2.1 NoteMyProgress Counselling Tool Pilot Project

NMP is a self-monitoring tool designed to support students' self-regulation strategies in online courses in an automatic and personalized way. Through interactive visualizations, it provides actionable aggregate information about student activity in the online course and their interaction with its contents. The aim is to encourage students to reflect on their learning strategies to motivate them to make informed decisions to improve their performance.

Although the tool was initially designed to be used in Coursera, NMP has an easily adaptable architecture for use in any other Learning Management System (LMS), such as by Moodle, for example, to support traditional or blended learning practices. Specifically, the tool consists of a web platform and a plugin for Google Chrome. The plugin handles collecting the student's activity on the LMS and offers the student the option of taking notes while studying the course. The web platform offers the visualization of the student's activity in a graphic and interactive way to facilitate the monitoring of their activities. This first version includes a notebook so that the student can take notes on relevant content by detecting. These two features also provide support for student learning within the course.

Resources

This section describes project resources to be used in the pilot of the NMP tool.

- **Web server**. A web server is available to host the NMP web application.
- **Google store account**. A developer type user is available to host and distribute the NMP plugin to users (students).

- **Computer technician**. A computer technician oversees providing support to ensure the availability of the tool while the pilot is underway.
- **Research team**. There is a team of 4 people in charge of the collection and analysis of the data collected during the pilot period.
- **Pilot team**. There is a team in charge of piloting the tool.
    1. ***Project Coordinator*.**
    2. ***Specialists in technological infrastructure***.
    3. ***Group for training, pilot project support and monitoring***. This team is in charge of preparing and disseminating the material for the training and support of the students during the period of the pilot, preparing the NMP tool with the necessary information about the courses in which the pilot takes place, inviting students to participate in the pilot, sending evaluation surveys, following up after the pilot, making adjustments during the pilot, documenting the process, and extracting data for analysis.
- **Online learning platform***.* The pilot was carried out with 3 courses of this platform.
- **End users.** The end users are the students who take the MOOC courses. According to the latest report presented by the Directorate of Engineering Education in April 2019, about 410,000 students had registered and there were over 2,000,000 visits to our MOOC courses.
- **Course lecturers.** Although the MOOC lecturers are not the direct users of the NMP tool, support is offered by the 7 lecturers who design the courses to carry out piloting the tool in their courses.
- **University Ethics Committee*.*** The process of piloting, collection, handling, confidentiality and storage of data, has been approved by the ethics committee of the PUC-Chile (http://eticayseguridad.uc.cl/).
- **Directors**. Support is given by the Head of the Directorate of Engineering Education (DEI) Dr Jorge Baier, as well as support from the team of professionals at the directorate (https://www.ing.uc.cl/equipos/direccion-de-educacion-en-ingenieria/).

Methodology and Planning

Error! Reference source not found.5 presents the phases, activities, dates, methodologies, efforts, and artefacts for the execution of the pilot project. Although a first prototype of the NMP tool was initially funded by Chile's National Commission for Science and Technology (CONICYT) between 2017 and 2018, its beta version was completed within the LALA framework, when PUC-Chile joined the 2018 project. Thanks to the LALA project, PUC-Chile has had the opportunity to pilot and improve the tool to offer an initial stable and scalable version.

Phase	Activity	Start date	Termination date	Methodology
Preparation	Artefact development	12-01-2018	15-03-2018	Artefact development
	Socialization of the pilot plan with stakeholders	15-03-2018	28-04-2018	Informative message during the first class of the online courses. Expert invitation via email.
Agreement	Agreement with participants	15-03-2018	28-04-18	Read and sign informed consent online.
Training	Definition of requirements and training for technicians	12-12-2017	03-03-2018	Integration of the technician into the NMP development process

	Training for users	15-03-2018	20-05-2018	Self-training by means of installation and use manual, since they are massive courses.
Use	User support	15-03-2018	22-07-2018	Remote support via email
	Socialization of experiences	01-03-2019	31-01-2020	Publication of results in conferences and journals.
	Evaluation	15-04-2018	10-07-2018	Using standardized questionnaires sent by electronic means. Analysis of the logs of the tool and the Coursera platform.
Evaluation and Improvement	General evaluation	08-07-2018	10-07-2018	Analysis of the results of the evaluation process in use phase

Table 4-15. Counselling pilot project in NoteMyProgress

The development and results obtained after carrying out each of the activities of the phases mentioned are shown in **Error! Reference source not found.**.

Phase 1: Preparation

Processes included in the pilot project

The development of NMP was initially funded by the Chilean National Commission for Science and Technology (CONICYT) between 2017 and 2018. The result of this initiative was a pilot version of NMP, an academic counselling tool designed to support students' self-regulation strategies in online courses in an automatic and personalized way. In 2018, PUC-Chile joined the LALA project and a stable version of the tool was completed to be used and tested in real contexts.

This pilot aims to test and evaluate the tool in real contexts on small and large scales to provide greater support to MOOC students to improve their performance in this type of course.

The NMP tool was launched in 11 different courses (see **Error! Reference source not found.**4-16), where a total of 1054 students were registered to download and install the tool.

	Course	Enrolled Students	Active students	Teachers
1	Electrons in action	6082	4841	3
2	Management of effective organizations	3395	2335	1
3	Constructivism room	2945	2114	1
4	Towards the excellence in project management	15657	11312	3
5	SMEs management	11056	7890	4
6	Learning to program in Python	12865	10275	4
7	Semantic web	1528	1000	1
	Total	**53528**	**39767**	**17**

Table 4-1. Number of students who download and install NMP in the different courses.

However, the final analysis of the tool's impact was carried out with a sample of 263 students, corresponding to the group of students who answered all the project's questionnaires. Of these 263 subjects, registered for the courses "Managing Effective Organizations" and "Road to Project

Management Excellence", 91 downloaded and used NMP and 172 did not. These two groups will serve as an experimental and control group, respectively.

Table 4-17 shows the detail of the two courses to which the evaluated population belonged (263 subjects from the total sample of 657, of which 91 used NMP (NMP Group) and 172 did not (NoNMP Group)), the duration in weeks, the number of video-readings in the course, the number of evaluations, and the number of supplementary activities. The supplementary activities correspond to a category used by the Coursera platform to refer to the reading of texts describing activities, case studies, instructions, and welcome messages.

Course	**Course content**
[MOOC 1] Managing Effective Organizations	7 weeks 42 video-readings 6 evaluations 7 additional activities
[MOOC 2] The road to excellence in project management	5 weeks 26 video-readings 4 evaluations 0 additional activities

Table 4-2. Description of the MOOCs analysed in the NMP online pilot.

During the pilot they were involved from the enrolment of the student in the MOOC course until it ended.

- The enrolment process for course participants was not changed for the pilot. That is, students can register for free in the courses offered by the university through the Coursera platform.
- Once registered, all course participants will receive an email presenting the NMP tool and explaining the advantages it offers as a complement to the course. In addition, the email includes a link to the tool so that interested participants can download and install it. The installation is voluntary, and participants will not receive any remuneration for participation in the pilot. The email will be sent during the first and second week of the course, as participants have two weeks to register for the course (see PUC-Chile Annex 1).
- All students who agree to participate in the study must first accept an informed consent form (see PUC-Chile Annex 2). Once their consent has been accepted, they will be redirected to a document with the following information (see information document):
    - A tool installation manual (see PUC-Chile Annex 3)
    - A questionnaire to measure their self-regulation strategies (see PUC-Chile Annex 4). This questionnaire will also be answered on a voluntary basis and is not a requirement for downloading and using the tool.

Current situation of processes included

Since this pilot project does not include comparative measurements between the results obtained during the pilot and previous years, it is not necessary to create a baseline. The evaluation of the usefulness and impact in general and specifically on student performance will be carried out based on the results obtained after the pilot.

Phase 2: Agreements

Description of the pilot population

A total of 19,052 students were registered in the two MOOCs involved in this pilot, of which 1054 downloaded NMP, and 657 of them used the tool in some extent. Of the total number of students registered, 990 students completed the course. Of all the registered participants, only the 263 students who answered at least the self-regulation questionnaire were considered for the pilot study. Of this group, 91 downloaded and used the NMP tool (classified as the NMP Group) and 172 did not (classified as the NoNMP Group). In addition to the participating students, the 27 lecturers and assistants in charge of the courses agreed in advance to use their courses in the pilot.

This pilot, as well as all derivatives with the NMP project, were previously approved by the ethics committee of the PUC-Chile (see PUC-Chile Annex 5).

Table 4-3**Error! Reference source not found.** shows detailed information of the pilot population, as well as the list of documents sent to participants during the pilot.

Role	Quantity	Unit	Comments
Lecturers (Total: 7)			
"Effective Organizational Management"[MOOC1]	3	School of Engineering, Industrial and Systems Department	In addition to the main lecturer who teaches the course, two teaching assistants participated in the pilot. The main lecturer of the course accepted via email that the course would be used for the NMP pilot.
"The road to excellence in project management" [MOOC2]	4	School of Engineering, Department of Construction Management Engineering	In addition to the two main lecturers of the course, two teaching assistants participated in the pilot. The main lecturer of the course accepted via email that the course would be used for the NMP pilot.
Students (Total: 263; NMP users: 91 Non-NMP users: 172)			
"Effective Organizational Management"[MOOC1]	**91** (NMP users: 24; Non-NMP users: 37)	*Not applicable*	**Submitted documents, informed consent forms and questionnaires:** - Study invitation email (see PUC-Chile Annex 1). - Informed consent (see PUC-Chile Annex 2). **Participants' demographic information:** - **Men**: 168 (~64%) - **Women**: 95 (~36%) - **Level of studies**: 143 (~54.4%) Master's degree; 27 (~10.3%) Secondary education; 4 (~1.5%) Doctoral level
"The road to excellence in project management" [MOOC2]	**172** (NMP users: 67; Non-NMP users: 135)	*Not applicable*	

Table 4-3. Description of the pilot population and summary of the documents sent during the pilot to the students participating in the study.

Phase 3: Training

Description of the training phase

Given the characteristics of this pilot, only those course participants who volunteered to use the tool were trained. In this case, given that in MOOCs there is no direct contact with students, a digital manual was offered that shows how to install the NMP tool and an explanation of its main functionalities.

The manual (see PUC-Chile Annex 3) was offered via an email that was sent to participants. In addition, a contact email address to answer questions was offered in this email. The doubts received were answered and were mainly related to the installation process.

Phase 4: Use and Impact

The Coursera platform and the NMP tool automatically record the actions that users perform on them. These records have been analysed to determine impact on student participation with course resources.

The analyses used the data sources presented in Table 4-4. From the data used, a series of indicators are extracted that will allow the use and impact of the tool on student performance to be evaluated.

Data source	Description of data and indicators
NMP logfiles	These logfiles record the actions recorded by the students in each of the functionalities offered by the tool. From these logfiles, the frequency of student interaction with each of the functionalities is calculated: 1. Display time indicators (time_vis_interaction) 2. Planning goals (goal_interaction) 3. Create and record notes (note_interaction) 4. Compare one's performance with the performance of one's peers (s_c_interaction) 5. Display general self-regulatory performance indicators (nmp_interaction) 6. Views related to the self-evaluation of study strategies (effect_interaction)
Coursera logfiles	These logfiles record the actions recorded by students with the various resources offered in the course. From these logfiles, a series of indicators are generated to measure students' commitment to the course: 1. Interaction with exams: frequency of interaction with course exams. 2. Video lessons started: frequency of interaction with video lessons that students start but do not finish. 3. Video lessons completed: frequency of interaction with video lessons that students begin and end. 4. Supplementary material started: frequency of interaction with supplementary material offered in the course started but not finished. 5. Completed supplementary material: frequency of interaction with supplementary material offered in the course started and completed. 6. Supplementary material interaction: frequency of interaction with the supplementary material offered in the course on a momentary basis, as a way of navigating through the course.
EFLA	Answers to the EFLA questionnaire. The average value of participants' responses for each question and per dimension was calculated for analysis (for details on EFLA, see the description of the materials provided for the pilot in section 1 of this document).
SRL Questionnaire	Answers to the EFLA questionnaire. For analysis, the average value of participants' responses for each question and per dimension was calculated (see the description of the materials provided for the pilot in section 1 of this document for details on the SRL questionnaire).

Table 4-4**.** Description of MOOCs.

Descriptive statistics of use records

Error! Reference source not found.4 shows the percentage of interaction with the most frequent NMP tools among the 657 subjects who used NMP. Table 4-5 offers more detail on the average interactions of the use of NMP by the 91 students who are part of the 263 students that comprise the complete sample that was considered for the impact analysis. Specifically, Table 4-20 shows the average value of the number of interactions recorded by the participants with the different functionalities.

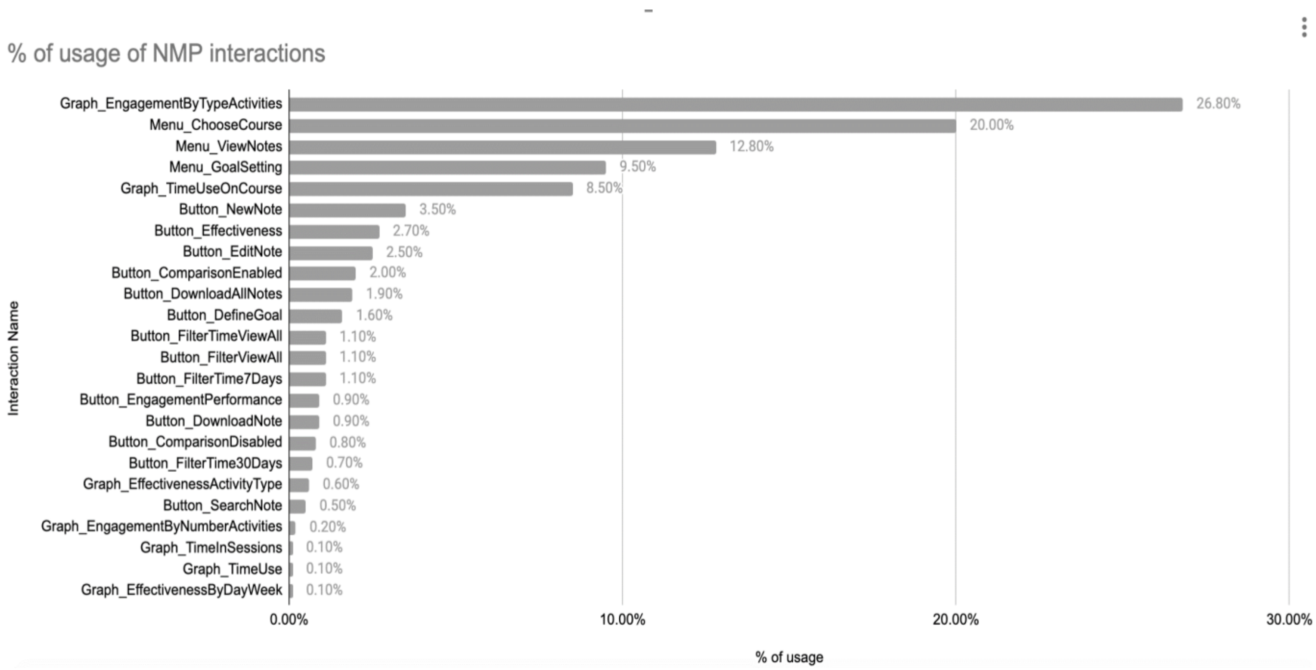

Figure 4-34. Percentage of the interactions of the 263 subjects who downloaded.

The results of Table 4-5 show that:

- The most used functionalities of the tool are, in this order: (1) those that show general displays of self-regulatory performance; (2) note-taking functionality; and (3) study goal-setting functionalities.
- There are certain differences in the frequency of interaction with the tool's functionalities between students who pass and those who do not pass the course. Specifically, students who pass the course are seen to use the tool more, and a statistically significant difference is observed with their peers who do not manage to pass the course in the functionality of setting goals and comparing their performance with the rest of the participants.
- Finally, there is also a difference in the final performance of the students in the course, with those who passed the course getting a better grade.

NMP Group	**Passed the course**		**Did not pass the course**			
Indicators	mean	sd	mean	sd	t	p
Interactions with the note taking functionality (note_interaction)	3,692	7,341	2,584	6,043	0,682	0,499
Interactions with the goal setting functionality (goal_interaction)	**1,807**	2,154	**0,984**	1,397	1,802	**0.080***
Interactions with the functionalities related to the time of study in the platform (time_vis_interaction)	0,923	4,316	0,307	1,951	0,698	0,490
Interactions with self-regulating performance overviews (nmp_interaction)	20,730	39,536	8,338	14,274	1,558	0,130
Interactions with displays related to strategy self-evaluation (effect_interaction)	0,961	4,902	0,061	0,348	0,935	0,358

Functionality that allows one to compare one's own performance with that of one's fellow students (s_c_interaction)	**0,923**	2,544	**0,030**	0,248	1,784	**0.086***
Number of students	26		65			
Grade in the course	**0,929**	0,056	**0,322**	0,215	21,002	**0.0001*****

Table 4-5**.** This table shows the average frequency of interactions with the different NMP functionalities recorded by the participants. A distinction is made between the group that passed the course and those who did not, also showing the grade obtained in the course (normalized between 0 and 1). Note: *p < 0.1; **p < 0.05; ***p < 0.001.

NoteMyProgress use and utility survey

To evaluate the usefulness of NMP, the EFLA questionnaire was applied (see PUC-Chile Annex 4) and a question was left open. The questionnaire was completed voluntarily by 57 students out of the 91 students sampled for analysis.

The results (see Table 4-6) show that students consider the tool to be balanced in all its dimensions: in the level of information offered on the data shown (65,367 out of 100); in the level of awareness and reflection on the indicators offered (68,533); and in the level of the tool's impact on students (67,822).

Dimension	**Question**	**Average value**	**Score for each dimension (0 -100)**
Data	P1: The tool clearly displays the information collected.	6,638	65,367
	P2: The tool clearly shows why the data shown is collected	7,128	
Awareness & Reflection	P3: The tool allows me to become aware of my learning situation	7,745	68,533
	P4: The tool allows me to predict my future learning situation given my change (or not) in behaviour	6,681	
	P5: The tool stimulates me to reflect on my learning	7,289	
	P6: The tool encourages me to adapt my behaviour in the course if necessary	6,958	
Impact	P7: The tool stimulates me to work more efficiently	7,630	67,822
	P8: The tool stimulates me to work more effectively	7,577	

Table 4-6. Average values given to each of the dimensions in the EFLA questionnaire.

Analysing the comments on the open question, "What uses have you made of this tool or how has it served you?", we observe that students value NMP for time management, goal setting and strategic planning, organization of their study and self-evaluation of their progress in the course. For example, some participants comment, in relation to time management, that NMP told them how much time they spent on the course, their waiting time during a study session and when they were most efficient: "This tool has helped me to quantify time in the course versus time in other activities."

Regarding goal setting and strategic planning strategies, participants commented that NMP was useful for planning and organizing activities, as well as for reflecting on their study habits and re-planning their work sessions. One student commented on this: "This tool has helped me to identify my free time during the study session and to create plans to improve the use of time”.

Other students valued the note-taking functionality as a support for organizing their work: "This tool has helped me to make summary sheets of the advanced topics." Finally, some students commented that NMP was useful as a self-evaluation, to follow up on their performance, monitor their progress in the course and get feedback on their own activities. For example, one of the students said: "NMP is a great thermometer for assessing whether progress is correct and taking action to ensure timely compliance," while another commented: "This (NMP) has allowed me to concentrate and be more effective in my study."

Impact on student performance results

Table 4-72 shows the level of commitment to MOOC materials and resources by students who used NMP (NMP group) compared to those who did not (NoNMP group).

The results show that students who used NoteMyProgress:

- Had a greater commitment to evaluations and video lessons
- Completed more video lessons and initiated more supplementary activities
- Scored higher than students who did not use the tool
- The level of self-regulation reported by students is not related to their level of commitment.

	NMP Group		**NoNMP Group**			
Indicators	mean	Sd	Mean	sd	t	p
Interacted exams (exams_interacted)	**3,054**	1,688	**2,375**	1,877	2,986	**0.003****
Video Lessons Started (lectures_started)	**9,197**	6,451	**7,075**	6,026	2,598	**0.01****
Video Lessons completed (lectures_completed)	**10,417**	6,338	**7,589**	6,586	3,398	**0,001*****
Video Lessons interacted during a very short time (lectures_interacted)	**19,615**	11,189	**14,664**	11,525	3,381	**0,001*****
Supplementary material started (suppl_started)	**0,505**	1,205	**0,115**	0,492	2,958	**0.003****
Supplementary material completed (suppl_completed)	0,703	1,433	0,595	1,638	0,552	0,580
Supplementary material interacted in a very short time (suppl_interacted)	1,208	2,307	0,710	1,882	1,774	0,078
Number of students	91 (100 %)		173 (100 %)			
Passed the course	26 (28.5 %)		30 (17.4 %)			
Did not pass the course	65 (71.5 %)		143 (82.6 %)			
Grade at the end of the course	**0,495**	0,331	**0,358**	0,323	3,217	**0.002****

Table 4-7. Average values of the frequency of interaction of participants with MOOC materials, distinguishing between groups that used the tool (NMP Group) and those that did not (NoNMP Group). Note: *p < 0.1; **p < 0.05; ***p < 0.001.

Phase 5: Evaluation and Improvement

Description of evaluation and improvement

Based on the use data of NMP collected during the pilot, results were analysed to see if they showed that the initial objective was achieved: **to offer greater support to the students of a MOOC to improve their performance in this type of course**. Based on this evaluation, an analysis is made of possible improvements and transformations to use this tool for other MOOC courses within the institution and to scale up its use in other institutions.

From the results of the pilot, NMP meets the initial expectation of offering a tool to support MOOC students in the performance of their course.

Results related to the utility (adoption) of NoteMyProgress

The results show that NMP can serve as a good complement to MOOC courses. It helps students make decisions about their time management, planning, and organization through note taking. At the time of the pilot, Coursera does not have specific features to help students self-regulate and improve their planning and performance in the course. NMP fills these gaps by providing visualizations and data on student behaviour that allows students to have a more complete picture of their actions related to the content. The results show that the most highly rated features are: (1) strategic planning by students using a weekly goal form; (2) note taking as a meta-reflection exercise on course content; and (3) comparison of one's own activity with that of other students. Students who use the tool value NMP as a useful tool to improve course time management, plan their weekly objectives and goals and become aware of their execution, and to take notes related to the course.

NoteMyProgress impact results (commitment and performance)

Although the characteristics of the pilot study and the participant population do not allow us to extract conclusive results on the direct impact of NMP on student engagement and performance, they do suggest that this tool could be a potential solution to motivate their activity in the course and, therefore an improvement in their performance. The results show that students who used NMP interact more with the different activities of the course compared to those who did not. Results also show that students who used NMP get a better grade in the course and are more likely to finish the course.

Summary of improvement proposals

With the results obtained, some ideas have been gathered to improve the tool and to extend its use to other courses both inside and outside the institution. Some of these are discussed below:

1. **Give more visibility to the functionalities related to setting study goals, taking notes, and comparing one's own activity with that of other students**, because these are the functionalities that are most highly related to course performance.
2. **To offer the tool in a more integrated way in the platform in which it is offered**. Coursera is limited in this aspect, since it does not offer the possibility of integrating tools with the functionalities offered in NMP. However, there are plans to explore the possibilities that the

Coursera platform has been offering for the last few months to integrate some visualizations that could help support some of the functionalities that NMP offers today.

3. **Adapt the NMP tool for other LMSs, such as MOODLE, which are platforms open to all.** This would offer the possibility of integrating NMP into many more courses in Latin America, in universities that do not belong to the Coursera group.
4. **To propose summary displays for teaching staff.** One of the aspects that the current NMP tool does not include is a visualization for teaching staff. Currently, lecturers have the visualizations that Coursera offers about student performance of different activities, but Coursera does not offer information like what NMP captures, the time they invest in their study sessions or planning. A summary of this type of information could help the lecturer to make specific interventions to motivate student participation at certain times during the course.

The improvements to points 1, 2 and 3, related to improvements of the existing tool, and the design for the adaptation of the NMP tool to Moodle were worked on with KU Leuven. Specifically, a workshop was held to propose a series of visualizations that should be included in the new tool adapted to Moodle. The NMP Moodle tool is in the process of development and is scheduled for completion in May 2020, to carry out proof of concept with teaching staff during the month of September 2020.

Post-pilot analysis results

This section presents the **list of lessons learned** from the pilot carried out, to scale up the use of the tool to other courses of the institution or other institutions that also use the Coursera platform.

- **Key roles for the development of the pilot.** Three key roles are required for the organization and execution of the pilot:
    - A **pilot leader** in charge of defining the pilot plan and coordinating the relationship with the rest of the roles. This person should be responsible for the following tasks: (1) planning the pilot and the ethical management needed to be able to conduct the experiment; (2) preparing the informed consent documents for approval by the ethics committee prior to launching the pilot; (3) preparing the content to be included in the course, such as links to the tool and manuals and invitation emails to students; (4) being responsible for coordinating the pilot from planning to execution, data collection and analysis.
    - A **technical person** in charge of adapting the tool for the courses in which the pilot will be carried out and of downloading and updating the data on a weekly basis. As NMP is an experimental tool it is necessary to make (1) an adaptation to the course contents; and (2) a weekly update of the data on the activities carried out by the students in the course. These two tasks must be performed manually by a technician.
    - A **data analyst.** Once the project is completed, a data analyst must oversee collecting and analysing the logfiles collected both through the Coursera platform and through NMP. From this data, an analytical report must be generated to be shared and disseminated within the institution.
- **Instruments for data collection and evaluation.** All questionnaires and instruments needed for data collection must be validated and prepared in advance to avoid user confusion about the terms used.

In addition to the lessons learned, we have identified **some aspects of improvement for the planning of an** upcoming **pilot**:

- Include an **interview with some of the students** who used the tool. Conducting an in-depth interview with some of the students who used the tool could give clues about aspects of improvement not covered in the questionnaires used in this pilot.
- Include a **meeting to socialize the analyses of the pilot with the teaching staff**. This meeting could offer teaching staff information about their course as an alternative to the information currently offered by Coursera.

4.3.2.2. Pilot of NoteMyProgress Counselling Tool in a Flipped Classroom Course

The NMP pilot for the flipped course is done by adapting the NMP beta tool described in section 4.2.1 of this document.

Resources

The technological resources used for the pilot are the same as those described in section 4.2.1. of this document. The research team is also maintained. However, in the pilot team, in addition to the technician, includes the lecturer and the 8 assistants involved in the design of the flipped course.

Methodology and Planning

The course was structured for the 11 weeks that a traditional course lasts, starting in August 2018 and ending in November 2018. Each week the students in both groups (control and experimental) had 2 sessions of 1.5 hours each and a series of activities to do at home. In addition, the course had several evaluations for both groups. Table 4-8 shows the list of evaluations and grades that were considered to establish the final grade of the students in the course.

Evaluation activity	**Description**	**Percentage of the final grade**
3 partial exams (E1, E2 and E3)	Two hours of on-site examination on the contents of the course.	20% per exam
Final exam	Replaces the lowest midterm score	20% corresponding to the partial exam that it replaces
Questionnaires at the beginning of each class	Average score of the questionnaires that are reviewed at the beginning of each face-to-face class	20%
Weekly planning	Evaluation of the weekly planning carried out	10%
2 group tasks	Grade obtained in the group task carried out during the onsite classes, and completed, if necessary, after class.	5%
Attendance grade	Average mark given by the lecturer to evaluate the participation of students in debates and face-to-face classes	5%

Table 4-8. Evaluation activities considered to establish the final grade of the students in the course.

Phase 1: Preparation

Processes included in the pilot project

The main process that was involved for this pilot was the enrolment of students in the MOOC course. To facilitate the process, course assistants were responsible for registering all the students on the course with the MOOC in Coursera before the start of the course. This facilitated training and integration of the platform as another resource in the learning process.

In addition, students completed an adaptation of the informed consent that was used in the first pilot (see PUC-Chile Annex 2). The pilot was part of the set of pilots and therefore the same detailed process took place in Phase 1 of the online pilot.

Phase 2: Agreements

Description of the pilot population

A total of 242 students participated in the pilot, divided into an experimental group with 133 students (who used NMP) and a control group of 109 students (who did not use NMP). The average age of the participants is 21 and the selection of the control group and the experimental group were determined by the lecturer without the students knowing their situation *a priori*. The University's ethics committee approved this pilot (see PUC-Chile Annex 5), as in the pilot detailed in the previous section.

Phase 3: Training

Description of the training phase

In the first class, 15 minutes were dedicated to explaining the methodology and to presenting the MOOC course and the NMP tool (only for the experimental group) to the students who participated in the experiment. The assistants made an interactive presentation showing the students how to access the MOOC and how to register in the NMP tool if they belonged to the experimental group. This was counted as a training phase for the students related to the new methodology and the work environment of the course. All the pilot's students participated in the training. The lecturer and the eight assistant lecturers also participated in a 30-minute training session on the tools to be used: Coursera and NMP.

Phase 4: Use and Impact

For the analyses, the data sources used are presented in Table 4-9.

Data source	Description
MOOC logfiles in Coursera	Logfiles recording the activity of the students in the control group and the experimental one in the MOOC displayed in Coursera.
NMP logfiles	Logfiles recording the activity of the students of the experimental group in the NMP tool.
Final grades	Students' final grades on the course

Table 4-9. Data sources used to analyse the impact of NMP on student involvement in the MOOC course.

In order to analyse the impact of the NMP tool on the students' involvement in the course, two analyses were carried out on: (1) performance impact analysis, comparing scores between the experimental and control groups; and (2) impact on student engagement, comparing student interactions in each group with MOOC activities. No usability tests were performed in this case, as the results of the first pilot were taken as a reference.

Performance impact

A t-test was carried out with the average grades of the two groups to compare grades between the experimental and control groups. The results of this test did not indicate a significant difference between the mean scores of the two groups (-1.39, p=0.165).

Comparison of student involvement in the MOOC

To make the comparison, we calculated the average number of interactions of each group with each of the MOOC activities week by week. A T-test was then conducted to assess whether there were significant differences between the various interactions. Table 4-*10*5 shows a summary of these analyses. The results of this Table 4-show that, when a week-by-week analysis of the recorded interactions is made, the experimental group shows a statistically significant higher activity (with a 95% to 99% confidence interval) in the last 4 weeks of the course (week 7, 9, 10 and 11).

Week	**Mean experimental group (Number of interactions)**	**Mean control group (Number of interactions)**	**T**	**p**
1	707	607	-1.03	0.3049
2	1141	1013	-1.21	0.2271
3	**1916**	**1530**	**-2.54**	**0.0119****
4	665	702	0.49	0.6238
5	688	640	-0.66	0.5126
6	573	564	-0.14	0.8888
7	**604**	**118**	**-8.22**	**0.0001*****
8	**1245**	**923**	**-2.19**	**0.0299****
9	**309**	**57**	**-7.16**	**0.0001*****
10	**387**	**121**	**-6.18**	**0.0001*****
11	**592**	**360**	**-3.48**	**0.0001*****
# Students	109	133		

Table 4-10. Analysis of the mean of interactions with the MOOC during the different weeks of the course.

Figure 4- 2 shows the average interaction of both groups to visually compare the two groups. From this figure, the students in the experimental group show slightly more activity in the MOOC course than their colleagues in the control group. Both show peaks of activity prior to the mid-term exams scheduled in the course.

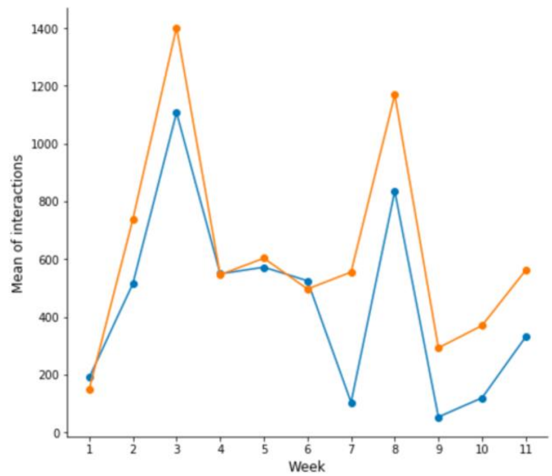

Figure 4- 2. Average of students' interactions in the MOOC week by week of the experimental group (orange) and the control group (blue).

Phase 5: Evaluation and Improvement

Main results

Based on the data obtained in this pilot, two main conclusions have been reached:

1. That the use of NMP helps students to maintain an activity on a MOOC throughout the course, especially in the last weeks of the course, where students usually relax.
2. That the use of NMP, although it does not have a major impact on students' final grades in general, does not place an extra burden on students, but rather can serve as support in flipped learning scenarios, where there is less lecturer support.

Proposals for improvement

Based on the pilot conducted, some of the improvements detected and described in section 4.2.1 of this document are corroborated, and some new ones are detected for the use of NMP in mixed learning environments:

1. **To provide a summary view to the lecturer of what is happening in relation to the weekly planning proposed by the students**. Lecturers' feedback highlighted the need to offer visualizations that allow them to understand how their students plan their course and what their real activity is in relation to their planning, in order to better organize face-to-face classes and adapt the activities to the students' reality.
2. **Provide supportive feedback to students on their weekly planning**. Some of the students commented during the pilot that, if they proposed a specific weekly plan, they would have liked to receive feedback from the assistants and lecturers to improve it and make it better.

4.3.2.3 Pilot project of the Dropout prediction tool

The Dropout Prediction Dashboard at MOOCs (DaP-MOOC) is a web dashboard designed to detect groups of students at risk of dropping out of MOOC courses early and automatically from student interaction with the course's digital resources. A set of visualizations provides information about students and their number according to the probability of dropout (high, medium, or low risk). The aim of the visualizations is to provide MOOC course assistants/tutors with a list of students classified by their probability of dropping out to offer personalized help messages to each of these groups, in order to retain them and avoid their possible dropout from the course.

Specifically, the tool is composed of a web platform that offers the visualization of the dropout probability of three groups of students classified as follows:

1. Students at high risk of dropping out (probability > 66%)
2. Students at medium risk of dropping out (probability > 33% and < 66%)
3. Students at low risk of dropping out (probability < 33%)

For this purpose, the information is presented graphically. This first version makes it possible to download the student IDs according to the group they belong to, to be able to selectively send personalized messages to each of the groups (see Figure 4- *3*).

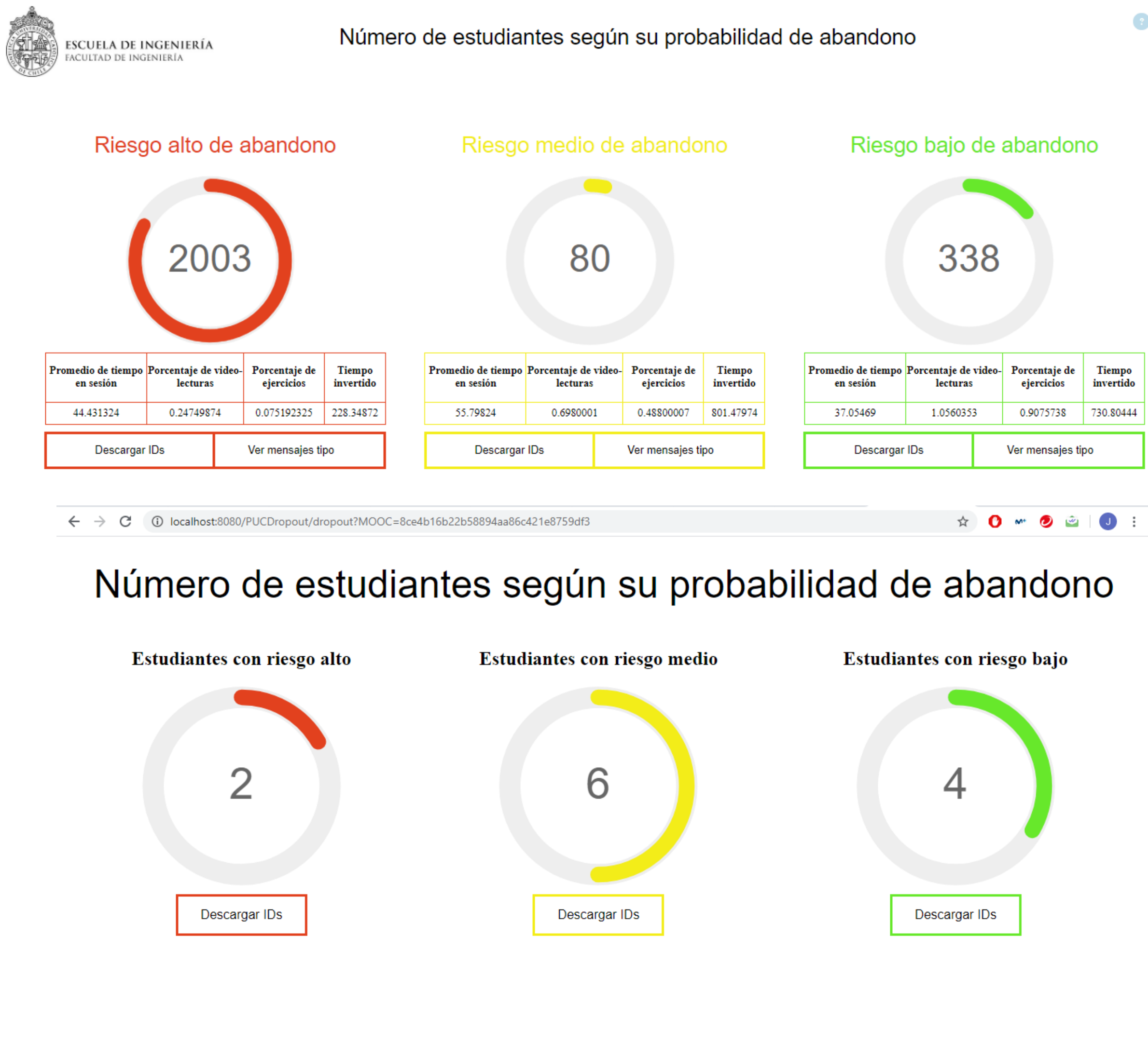

Figure 4- 3. DaP-MOOC dashboard screen

Within each circle, the number of students in each group appears, and the coloured circle around the number indicates the percentage that this number represents respect to the total number of students. Below the circles, there is a table with a description of the main indicators of the students in each group. These indicators include: 1) average time for each working session, 2) percentage of video-lectures completed (with respect to the total), 3) percentage of exercises performed (with respect to the total), and 4) time spent on the platform. Below those indicators, there are two boxes. The one on the left ("Download IDs") is used to download a file in .txt format with the identifiers of the students belonging to each group. When selecting this option, a tab is opened to select the file location and download the file. Finally, the button "View standard messages" on the right displays at the bottom of the screen the text of several possible messages that the instructor could send to his/her students to improve their behaviour.

Even though the tool was initially designed to be used with Coursera's MOOCs, Dap-MOOC has an easily adaptable architecture for use with any other Learning Management System (LMS), such as Moodle.

Resources

T This section describes the resources of the project to carry out the pilot of the DaP-MOOC tool.

1. **Web server**. A web server is available to host the DaP-MOOC web application.
2. **Computer technician**. A computer technician oversees providing support to ensure the availability of the tool while the pilot is underway.
3. **Research team**. There is a team of 5 people in charge of collecting or/and analysing the data collected during the pilot period.
4. **Pilot team**. There is a team in charge of piloting the tool.
    a. ***Group for training, pilot project support and monitoring***. This team is in charge of preparing and disseminating the material for the training and support of the MOOC assistants/tutors during the pilot period, preparing the DaP-MOOC tool with the necessary information about the courses in which the pilot is carried out, sending the personalized messages to the students to participate in the pilot, sending evaluation surveys, monitoring the pilot, making adjustments during the pilot, documenting the process, extracting data for analysis.
    b. ***Online learning platform***. PUC-Chile has 24 MOOCs in the Coursera platform(https://www.coursera.org/ucchile). In this pilot, one course hosted in this platform is used.
    c. ***End users.*** The end users are the assistants/tutors who give feedback to the students in the MOOC courses. According to the latest report presented by the Directorate of Engineering Education in December 2019, more than 500.000 students had registered and more than 2.000.000 visits to MOOC courses had been made. The number of registered students in the selected MOOC for the pilot is 140,590 registered students.
    d. ***Course assistants***. Although the MOOC teaching staff are not the main users of the DaP-MOOC tool, they are supported by the 2 assistants who designed the MOOCs along with the teaching staff to pilot the tool in their courses.
    e. ***University Ethics Committee.*** The process of piloting, collection, handling, confidentiality and storage of the data has been approved by the ethics committee of the PUC-Chile (http://eticayseguridad.uc.cl/).
    f. ***Directors***. Support is provided by the Director of the Directorate of Engineering Education (DEI), Dr Jorge Baier, as well as the support of the team of professionals of the Directorate(https://www.ing.uc.cl/equipos/direccion-de-educacion-en-ingenieria/).

Phase 1: Preparation

Starge1: Processes included in the pilot project

In this first stage, an analysis was carried out with past data from the three MOOCs that were taken as a reference to extract initial data: "Electrons in action", "Constructivist classroom" and "Management of effective organizations". The objective of this analysis was to verify that a high predictive power can be obtained from the available past data and to draw conclusions about which variables should be used in the predictive models used in the second stage of the pilot. In this case, no process was intervened either during the design or launch of the MOOC, since it is a first pilot for the validation of models.

The detail of the three MOOCs used as a data source is as follows:

(1) Electrons in Action - A total of 25,706 students are enrolled, but after filtering students, a total of 2,035 students were considered for testing.

(2) Constructivist Classroom - A total of 18,653 students are enrolled, but after screening of students, a total of 337 students were considered for testing

(3) Effective Organization Management - A total of 10,576 students are enrolled, but after screening students, a total of 526 students were considered for testing.

In this first stage, an exploration of the models was carried out to predict the success and final grades of the students, as well as their probability of dropping out. The results of this first stage were a series of models that would finally be incorporated into the final tool to be tested in a real course in a second stage. The details of the models used and the previous analysis are described in the first pilot deliverable of this project, as well as in two scientific publications.

Indicator extraction

From this first stage of analysis, the 4 indicators that were used to obtain the probability of dropping out of the students were extracted. These indicators were obtained from the Coursera Logs of the three MOOCs courses used as a reference in this first stage (see Table 4-26):

(1) Demographic variables, related to age, educational level, gender, occupation.

(2) Student activity on the platform (engagement), related to the number of days active on the platform, the total time of interaction on the platform and the number of study sessions for each student.

(3) Interactions with the videos, related to the number of video-readings completed, started, revisited, the proportion of videos taken whether completed or not, proportion of completed videos, proportion of videos revisited.

(4) Interactions with exercises, related to the number of assessments completed, initiated, revisited, the proportion of assessments taken whether completed or not, proportion of assessments completed, proportion of assessments revisited.

(1) Variables related to demographics	
(3a) Edu	Educational level
(3b) Age	Age of the learner
(3c) Isfemale	Categorical variable representing whether the learner is male or female
(3d) Emp_student	Categorical variable representing whether the learner is a student (in formal education) or not
(3e) Emp_job	Categorical variable representing whether the learner has a job or not
(2) Variables related to learners' activity	

(5a) Days_Act	Number of active days in the platform
(5b) Time_spent_min	Total time spent interacting in the platform (in minutes)
(5c) Num_ses	Number of sessions
(3) Variables related to learners' interactions with videos	
(6a) Vl_complete	Number of times the learner has completed a video
(6b) Vl_begin	Number of times the learner has started watching a video without finishing it
(6c) Vl_review	Number of times the learner has reviewed a video once completed
(6d) Prop_vlopen	Percentage of opened videos (completed or not)
(6e) Prop_vlcomplete	Percentage of completed videos
(6f) Prop_vlreview	Percentage of reviewed videos
(4) Variables related to learners' interactions with exercises	
(7a) A_try	Number of times the learner has started to do an assessment without finishing it
(7b) A_complete	Number of times the learner has completed an assessment
(7c) A_review	Number of times the learner has reviewed an assessment once previously completed successfully
(7d) Prop_atry	Percentage of attempted assessments (completed or not)
(7e) Prop_acomplete	Percentage of completed assessments
(7f) Prop_areview	Percentage of reviewed assessments

Table 4-11. List of indicators used in the pilot.

Development of predictive models

To develop the predictive models, a first analysis was made which consisted in analysing the success of the students in one of the courses (in particular, "Electrons in Action"). In this case, the dependent variables were the following: (1) final grade for the course, (2) success defined as obtaining a grade higher than 80% without any restriction regarding viewing a minimum number of videos and (3) success defined as obtain a grade above 80% having seen at least 50% of the videos. To carry out this analysis, five categories of independent variables were taken into account: (1) learning self-regulation strategies (SRL), (2) SRL patterns, (3) demographic variables, (4) variables on student intentions and (5) variables about the student's activity. In addition, three types of students were considered, identified by hierarchical grouping. The first group of students were the "sampling" students, who simply entered the course to "sample" some content and left. The second were the full students, who followed the itinerary designed by the instructor and completed the videos and activities. The third group was the strategic students, who were mainly focused on taking the assessment tests and watched fewer videos. Taking into account the variables and the groups, the prediction was made using regression models for each of the dependent variables and groups.

The results showed that the variables that had a greater relationship with the success or grade of the students were the SRL patterns and the variables related to the student's activity (in particular the time invested). Regarding the regression models for the prediction of the grade, the adjusted R2 for the different groups was 0.80 for the complete students, 0.72 for the strategic students and 0.86 for the group of all students (with p-value <0.001 in all cases). This indicates that the variables can explain a high variability in the model, although to a lesser extent for strategic students, who follow a less common itinerary. The RMSE (Root Mean Square Error) is between 0.12 and 0.18 for all groups, being worse for strategic students. Regarding the prediction of success, an excellent AUC (Area Under the Curve) is achieved (greater than 0.9) in all cases, except in the training set of complete students, which is obtained 0.84 (possibly because the number of samples is lower). However, it is observed that good prediction results can be obtained with SRL and activity variables, although other variables such as demographic or intentions have a worse relationship with the dependent variables.

After conducting the first experiment with a course, the analysis was extended to two more courses ("Constructivist Classroom" and "Management of Effective Organizations"). In addition, the focus was shifted towards the prediction of dropout. For the definition of dropout, a student was considered to drop out when they were at least 4 weeks without activity on the platform (if they had not completed 80% of the tests and it was considered that they had completed the course). For this analysis, given that the courses had an asynchronous mode of instruction, the time period of each specific student was analysed. In other words, the first week of the course was for each student the first week since they registered, instead of considering fixed dates on the calendar. Bearing this in mind, the groups of variables considered in the prediction of grades and success were used, plus two other sets of variables: video variables and exercise variables.

In a first analysis, the predictive power of the SRL variables was analysed. On the one hand, it was concluded that self-reported SRL variables (obtained through an online questionnaire) did not add value to predictive models. However, the SRL patterns achieved high predictive power (with an AUC greater than 0.95), which implies that the way in which students interact and self-regulation strategies influence dropout. Among the patterns, the one that was fairly common and rated students quite well was the pattern of opening the assessment and then going to the videos. Among other groups of variables, it was concluded that the video variables were also very good predictors, although the variables with the greatest predictive power were the exercise variables. This is sensible as, if a student does not complete the activities, they cannot complete the course, although the failure to keep the activities up to date from the beginning may give a future indication that the activities will not be completed.

Apart from analysing the predictive power, the transfer of predictive models was analysed, and it was concluded that some algorithms such as Decision Tree and support vector machines (SVM) were not consistent when transferring the models. The opposite case was with the Random Forest, in which it was observed that it could transfer the models generated from one MOOC to another MOOC, which is positive for the applicability of the models used in the pilot. Even if data from the same course is used in the pilot, it is also important to ensure that past data from a course can be used for prediction with new students to the same course.

Finally, a temporal analysis was carried out to see from what moment a high predictive power could be obtained in the models. The conclusion was that a good AUC could be obtained from between 25-33% of the theoretical duration of the MOOC (assuming one module per week and an excellent AUC between 43-67% of the theoretical duration of the MOOC. This implies that It is possible to obtain early predictions with sufficient predictive power. Therefore, the objective of the piloting will be to put these models into practice, in such a way that updated predictions are provided according to the weather and their predictive power is improved, although as soon as possible they are reliable enough to have an impact on learning.

Starge1: Processes included in the pilot project

The purpose of this second stage was to carry out an Intervention in the course "Introduction to Programming with Python" using as a basis the predictive models that were developed in the first stage of the pilot. This course is taught on the Coursera platform of the PUC-Chile. It is an asynchronous course and lasts for 6 weeks. However, as students can contemplate it in a longer time (as it is asynchronous), the piloting was carried out for 7 consecutive weeks, between July 2020 and August 2020, to better analyse the evolution. During this period 2,421 were active in the course and represent the analysis group of this pilot. It is noteworthy that these 2,421 students were those who enrolled in the first week of the pilot and who are followed up. Those who entered later were not considered, as their progress could be different at the same point in time.

Throughout these 7 weeks, two teachers had access to the dropout's website, where the risk of dropping out of different groups of students was indicated (http://dei-lala.ing.uc.cl:8080/dropout/ aCourse? prof = 7a675883b1c117e267470dce52eba518). For each group, a set of standard messages was proposed that could be sent to each student profile, in order to encourage them to continue in the course. The standard messages that were shown for each group of students according to their risk can be found in the Annexes part of this report.

Current situation of the processes to intervene

The objective of the pilot was to modify the monitoring process of the course teachers, improving the sending of personalized messages to students according to their risk. The message was sent on Friday of each week by the teacher, based on the data provided by the dropout tool. Messages were sent every week except for week 4, to leave students a week without notification in the middle of the course.

Phase 2: Agreements

The 2421 students mentioned above were active in the course and, therefore, represent the analysis group of this pilot. All students accepted the informed consent offered by Coursera when registering, where it is informed that the course teachers will be able to access the data of the students of the course. We do not have information about the gender or profession of these students, as Coursera does not offer information of this type.

In addition, two teachers (women) participated in the pilot, one who had participated in the generation of the course and one who served as an assistant to the course for follow-up.

Phase 3: Training

For this pilot, training was conducted for the participating teachers. Particularly, training was conducted online, through videoconference, and consisted of:

1. Presentation of the pilot objectives
2. Presentation of the tool
3. Example of sending messages
4. Testing in the tool by the two teachers.

In addition, during the pilot, the professors were assisted by a member of UC3M, who offered support in case of doubt or problems with the tool.

Phase 4: Use and Impact

For the evaluation of the pilot, the activity of the students in the course was analysed in order to detect whether or not the messages sent had had any impact on their behaviour. Specifically, the following data sources were used for the analysis:

- Coursera's "Logfiles". These files store students' activity with the course materials, and they track their activity with each of the offered resources.
- List of students in the different risk groups for each week (excepting week 4). Each week, excepting week 4, the group of active students in the course who belonged to each risk group was computed and registered.

With these data, two analyses were conducted. The first one consisted on calculating the percentage of students in each risk group each week (based on the list of students that belonged to each group) and computing the percentage of students of each group respect to the total.

The second analysis considered Logfiles from Coursera and the lists of students in the different risk groups. Specifically, an analysis of the probability of students in one group to move to another group was conducted week by week.

Percentages of students in the different risk groups

This section analyses the number of students (with their corresponding percentage) in each of the risk groups over the seven weeks of the pilot. Table 4-27 shows the distribution of students in each risk group and Figure 4- 37 shows the corresponding percentages, considering N = 2.421.

The main lessons learners from this table include:

1. Most of the students are classified as at-risk and from the beginning of the course (where there is only 0.8% with no risk). This is a normal result, typical of MOOC courses, where most students do not finish the course.
2. The percentage of students in the medium risk group decreases week by week, with around 45% of students in the first week and 3.3% in the last week.
3. The percentage of students in the no-risk group increases week by week, being 0.8% at week 1 and 14% at week 7, while the percentage of students with medium risk decreases decrease. This could mean that some of the medium-risk students are moving to the group of “no risk”.
5. The percentage of high-risk students also increases week by week. In week 1, there are already more than half of the students with high risk of dropout (53.9%) and this number significantly increases week by week until week 5. In the last weeks, this value seems to stabilize.

In summary, most movements between groups are among students who are initially at medium risk and move to non-risk or high-risk groups as the course progresses. Although it cannot be concluded from these results that students have been influenced by the messages, we do observe a positive trend for medium-risk students, who can potentially move to the non-risk group towards the end of the course. With regard to the movement to the high-risk group, as it is a common pattern of MOOCs, it is not identified as an especially negative aspect with respect to other MOOCs. Nevertheless, it would be interesting to see how that evolution of dropout can be influenced by the messages.

Week / demographic variables	**No Risk**	**Medium Rsk**	**High Risk**
(3a) Edu1	Educational level20 (0.8%)	1095 (45.2%)	1306 (53.9%)
(3b) Age2	Age of the learner145 (6.0%)	607 (25.1%)	1669 (68.9%)
(3c) Isfemale3	Categorical variable representing whether the learner is male or female167 (6.2%)	399 (15.5%)	1855 (76.6%)
(3d) Emp_student5	Categorical variable representing whether the learner is a student (in formal education) or not275 (11.4%)	179 (7.4%)	1967 (81.2%)
(3e) Emp_job6	Categorical variable representing whether the learner has a job or not287 (11.9%)	119 (4.9%)	2015 (83.2 %)
Variables related to learners' activity7	338 (14.0%)	80 (3.3%)	2003 (82.7%)

Table 4-12. List of indicators used in the pilot.

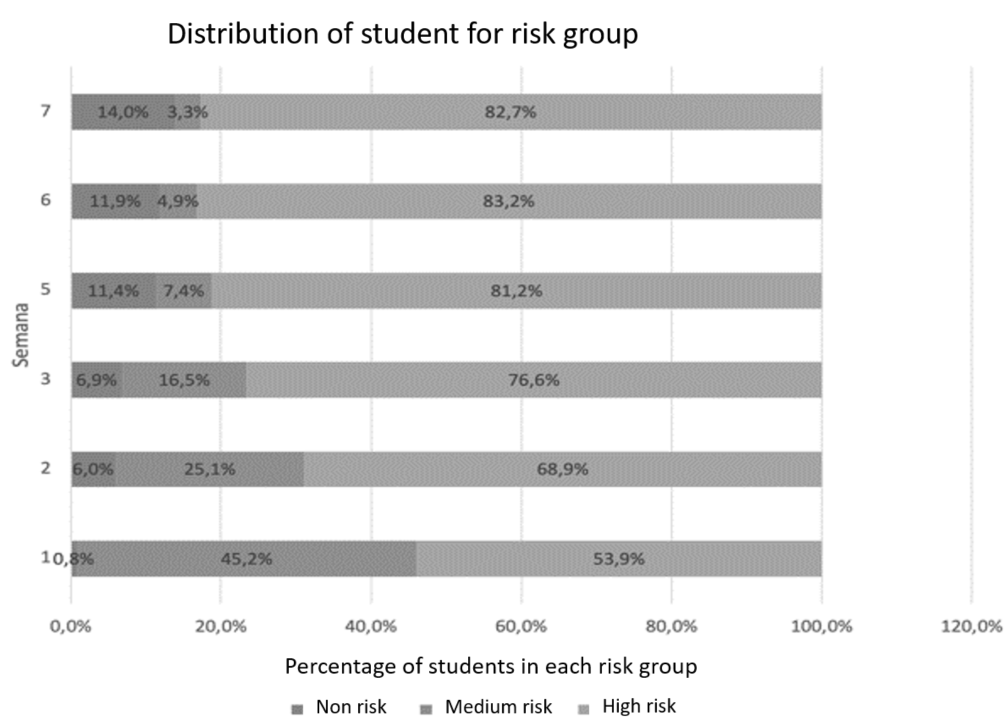

Figure 4- 4. Distribution of students in risk groups.

Students evolution in the different risk groups

Evolution of students in the different risk groups

This section analyses the evolution of students in the different risk groups week by week, considering the activity in the MOOC through the Logfiles and the lists of students that belong to each risk group week by week.

Figure 4-38 shows the percentage of students who belong to a risk group in a certain week (Y-axis) and the probability of moving to another risk group the following week (X-axis). The darker colours show the students groups with a higher percentage of students. For example, the first figure shows the evolution of students between week 1 and week 2. In this first figure we observe that 75% of the students without risk in week 1 are going to be without risk in week 2. Moreover, 5% of students of students at risk will continue being at risk and 20% will be in medium risk. However, if we analyse the movements from week 2 and 3, we observe that 7.13% of students who were at risk in week 2 move to other groups in week 2. This increases the overall number of students at risk.

These results show that students who move to the non-risk group continue in this group from week 5 onwards. In addition, medium-risk students mostly move to the no risk group between weeks 3 and 5.

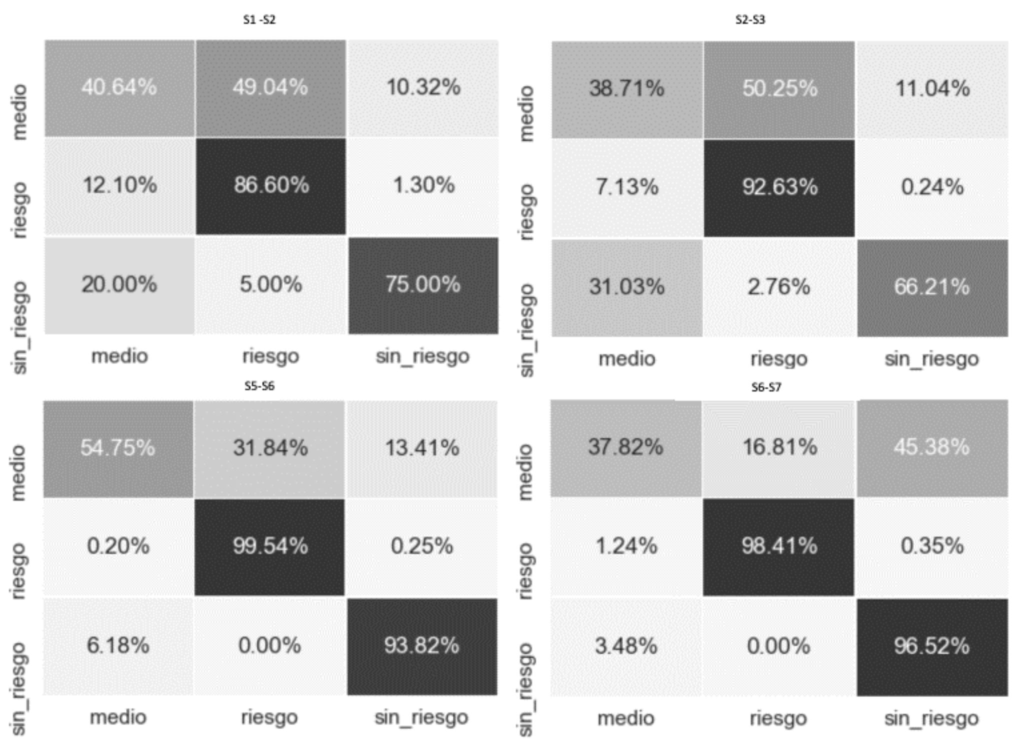

Figure 4- 5. Percentage of students in each group (medio – medium risk, riesgo – high risk, and sin_riesgo – no risk) and the probability of moving from one group to another. Y axis represents the initial week and X axis represents information related to week + 1.

Phase 5: Evaluation and Improvement

Teachers' perception of the tool

This section summarizes some of the aspects highlighted by the two teachers participating in the experiment on the use of the tool. These perceptions were collected through informal interviews and email exchanges that occurred during the pilot experiment.

The teachers highlight different advantages of using the tool. First of all, they appreciate being able to have a clear visualization about the probability of dropping out of students in the course. One of the teachers highlights “Although Coursera already offers several tools to visualize information about the students of the course, a tool was lacking that would show information to guide decision-making. The division into groups that this tool offers makes it easier”.

Second, the teachers value the possibility offered by the tool to send personalized messages in relation to their probability of abandonment. One of the teacher’s comments "It helped me a lot to be able to classify the students into groups in order to send more personalized messages." The other reiterates "It was very useful to have the list of students by group to be able to send the messages."

Third, the teachers value the examples of emails provided in the tool. The messages were appreciated as a form of communication between the teacher and the data provided, as well as to guide the teachers in sending the tool. One of the teacher’s comments: "The example messages helped me to interpret the data and better understand the statistics that the tool shows, in order to later personalize the messages better."

In addition, the teachers suggest some improvements to the tool. First, they highlight the lack of direct integration with the platform. Since Coursera is a closed platform, any complementary tool is external to it, despite the fact that it feeds on the data generated in Coursera. The teachers would have preferred to include the tool in Coursera to facilitate the sending of messages. One of them comments: "It would have been easier to find all the information that the tool offers on Coursera, to be able to directly integrate the sending of messages."

Secondly, the teachers also highlight that the tool lacks a functionality to track the messages sent. Although the teachers had an insight into the messages sent from the Coursera forums, they would have appreciated seeing.

Finally, they also suggest that a visualization could be integrated into the tool to see the evolution of the students throughout the course and observe the impact of the messages. One of the teachers mentions: "I would have liked to see the effect of the messages, that is, how the probability of dropping out varies throughout the course."

Learned lessons

The pilot shows that the tool could be successfully integrated into an existing process of monitoring students in a MOOC, improving the process of sending personalized messages.

Among the lessons learned, mainly 3 stand out.

- In online learning contexts, with information from many students, teachers value having visual information about the evolution of students that allows them to make decisions and carry out concrete actions. The second is that.
- Sending personalized messages is a mechanism valued by teachers, for its simplicity and its direct impact on the teachers' study process.
- Proposing sample messages for each group of students is a useful mechanism to communicate the information from the graphs to the teachers, as well as to guide them in the writing of the messages.

Among the potential improvements, the following lessons learned stand out:

- It is important to integrate the tool within the Learning Management System to facilitate data access and message management.
- The visualizations could include the trajectory of the students throughout the course, to see the impact of the messages.

4.3.3 Pilot Projects at University of Cuenca (UCuenca)

4.3.3.1 AvAc Counselling Tool Pilot Project

AvAc was created to enable a lecturer to give recommendations to a student regarding which subjects to take in the new semester, based on a visualization of academic data. This tool is used before the beginning of each semester (by students who need to request to take a subject for the third time or request to add new subjects), and in the middle of the semester (only students with low averages are invited to attend).

The tool was developed using NodeJS technologies with an implementation of two layers of abstraction: the model and the controller, together with configuration files for database connection and information needed for connection to the authorization server. A REST API was created for database access. To analyse the data generated by the tool, instructions were included in the code for the dashboards that enable a feed to a log with all the actions performed by the user (e.g., click, mouse over) and additional information (e.g. subject, display, icon, button).

Resources

The resources used for the execution of the pilot project were as follows:

- Server to host the tool
- Computer technician for service support (tool availability)
- Project researchers for data collection and analysis
- Pilot team
    - Project Coordinator
    - **Specialists in technological infrastructure**
    - **Group for training, pilot project support and monitoring**
- Participants:
    - Users involved in Academic Counselling Dashboard: 4 degree directors, 16 academic committee members or faculty, 2 administrative staff, and 522 students.
    - Users involved in the Evaluation Activity by Subject Results Dashboard: 41 lecturers and 500 students indirectly.

Methodology, Artefacts and Planning

Table 4-28 presents the phases, activities, dates, methodologies, efforts and artefacts planned for the execution of the pilot project.

Phase	Activity	Start date	Termination date	Methodology
Preparation	Artefact development	15 July 2019	20 July 2019	Prepare LALA Project Presentation and Academic Counselling Unit Proposal Presentation of the characteristics and use of the UCuenca Academic Counselling Tool Adaptation of perception surveys and work on the special application process for subject enrolment and withdrawal (UACH originals) Refine tool use log
Agreement	Agreement with the participants	20 July 2019	20 July 2019	Adaptation of informed consent (UACH originals)
Dissemination	Raise interest in other faculties and engage faculty. Several sessions were required to identify people prepared to commit.	15 July 2019	29 July 2019	Adapting the presentation of the features and use of the Counselling Tool Use of the Academic Counselling Tool with real data Notes: Initially this phase was conceived as training but there was scepticism regarding the use of the tool and the process.
Training	Training for users	20 Sept 2019	2 Dec 2019	Use of the Academic Counselling Tool with real data Knowledge test Pre-test questions (faculty) Guide for Academic Counsellors UCuenca Academic Attendance List
	Training for administrators	4 April, 2020	4 April, 2020	Meetings with the system administrator
Use	Monitoring of activities	22 April 2020 13 September 2020	3 May 2020 20 September 2020	SUS (System Usability Scale) Knowledge test Google Analytics
Evaluation and Improvement	Evaluation	7 May 2020	31 May 2020	Post-test questions (faculty)
	General evaluation	18 April 2020 23 April 2020	18 April 2020 23 April 2020	Meeting minutes /emails
	Documentation of improvements (in relation to training)	29 April, 2020	29 April, 2020	Report to the Academic Vice-Chancellor

	Analysis and Documentation of improvements (in relation to use)	21 May, 2020	3 September, 2020	Report to the Academic Vice-Chancellor

Table 4-13. Planning of pilot

A description follows of the development and results obtained after carrying out each of the activities in the phases mentioned in Table 4-28.

Phase 1: Preparation

Processes included in the pilot

At present UCuenca does not provide academic advice to students, although isolated efforts exist, which depend on the organization of the university's different faculties (12 faculties). These efforts are aimed at providing academic monitoring of students. Faculty members in charge of student monitoring are usually members of the academic committee, where, depending on the faculty, they include academic monitoring activities as part of their responsibilities. Faculty members obtain academic information from the university's computer systems. Furthermore, there is no defined academic counselling process, no time allocation for academic counselling activity, and no supporting computer tools.

In 2017 and 2018 a survey of learning analytics needs was carried out at the University of Cuenca as part of the LALA project. As a result of the cross-analysis of data obtained for the four Latin American educational institutions participating in the LALA Project, the following needs were identified:

- Students require quality feedback and data-based support from teaching staff in order to improve their learning outcomes.
- Students require timely support interventions from teaching staff and directors when they are experiencing difficulties that affect their academic performance.
- Teaching staff require timely alerts from directors to provide better support for students facing difficulties that affect their academic performance.

Based on the findings of this survey, it was decided to create an academic counselling tool that supports timely feedback and support to students in order to improve their learning outcomes. Furthermore, with the objective of providing teaching staff with tools that allow them to identify students who might be facing difficulties that affect their academic performance, it was decided to build a tool that allows them to analyse the academic performance of students in the subjects taught.

Consequently, UCuenca is not including a process but rather the pilot will be a first experience of the implementation of the advisory process.

Utility and impact baseline

After an initial design of AvAc, it was released for correction and improvement. Once the corrections and improvements identified in the dissemination sessions had been implemented, the pilot phase began in 4 faculties (Engineering, Chemical Sciences, Economic and Administrative Sciences, Hospitality Sciences) and baseline surveys were applied (see UCuenca Annex 1 and Annex 2). The artefacts used were adaptations of those provided by UACh. In the baseline study, those participating (degree directors, teaching staff, administrative staff) were asked about the current amount of work involved in requests for

enrolment for special courses (see Figure 4- 33), and their perception of the support available to carry out the process (see Figure 4- 36).
The results reveal that 16 of the 29 participants who responded positively to the question (3 of the 32 did not respond) consider it important for the university to offer students a face-to-face support service during the application process, improving support for the resolution of enrolment and withdrawal requests (Figure 4- 36).
According to Figure 4- 37(which reflects the amount of work related to special requests), of the 19 people who responded (out of 31), 7 people consider the number of requests for enrolment for special courses to be 50 or more per term; 5 people consider the number of requests to be between 26 and 50; and the remaining people consider the number of requests to be less than 26 per term. In addition, the survey providing the data for Figure 4- 33 establishes that each request takes between 2 and 5 minutes. In this survey (amount of work for special requests), 12 people out of 31 did not respond because their activities do not include dealing with special requests for subject enrolment or withdrawal.
In general, survey participants agreed that displaying student academic information as a dashboard is better than browsing through different reports. However, some participants expressed concern that there would be additional workload due to the need to adopt both a process and a tool for academic counselling.

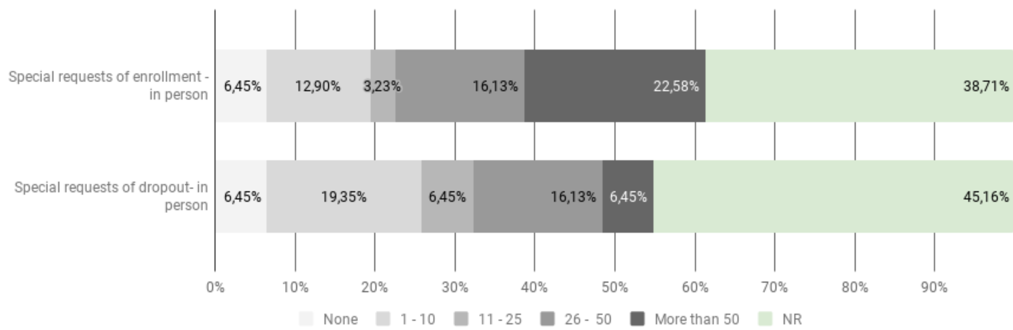

Figure 4-39. Number of special requirements per semester.

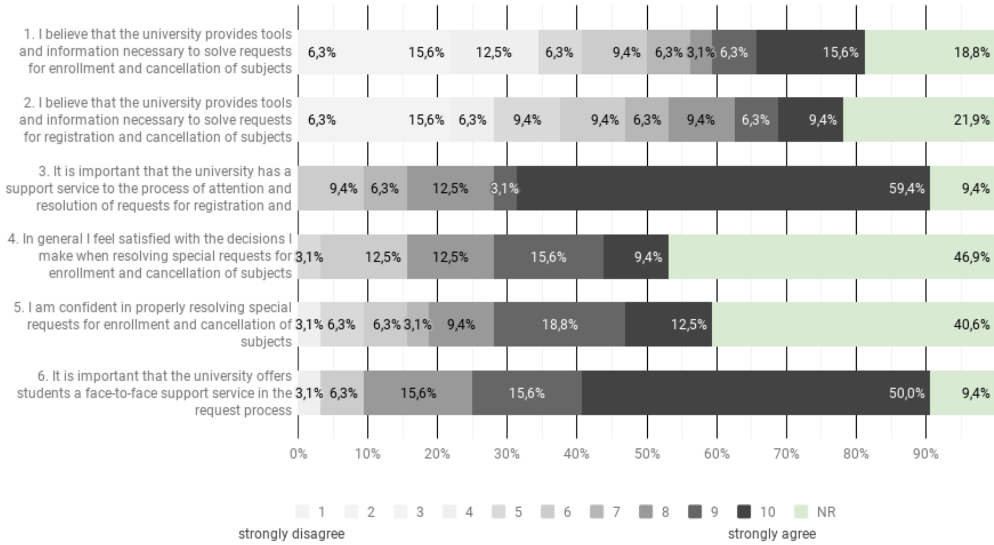

Figure 4-40. Perception of support received from the University regarding the task.

Phase 2: Agreements

As of the date of writing of this report, 16 participants have signed the declaration of consent corresponding to the Academic Counselling system, and Table 4-29 shows their distribution by unit. The artefact used is an adaptation of the agreement document provided by UACh (see UCuenca Annex 3).
As will be seen below, although 16 participants have signed the agreement, the tool has been made available to all training attendees who have requested it (45). This is why the number of active users (see Phase 4: Use) is greater than the number of people who have signed the agreement.

Unit	Quantity
Chemistry Science	4
Administrative and Economical Sciences	3
Hospitality Sciences	6
Engeneering	3
Total	**16**
Distribution by gender Women 11 (69%) Men 5 (31)	

Table 4-14**.** Participants who signed the agreement.

Phase 3: Training Report

Description of the training phase

The training sessions lasted two hours and took place in separate sessions for each different faculty. To this end, the deans of each faculty invited teaching staff from their respective schools. During these sessions, people who had not previously filled out the baseline surveys (during the previous dissemination sessions) did so, and the teaching staff who requested access to the tool were given participation agreements (45).

The following activities were carried out during the training session:

- Project LALA was presented, and the dashboard visualizations were explained.
- Participants used the Beta version of the tool, but it was fed with real data. Specific student cases were analysed. To this end, participants were requested to bring the identification numbers of students who wanted to analyse their academic situation to the training session.
- Using an online form, the teaching staff provided feedback on the training (not all accessed the online form).
- Teaching staff who signed the informed consent were provided with a guide for academic counselling.

Description of participants in the training phase

As can be seen in table 4-30, 79 people were trained (degree directors, members of the academic commission, lecturers, administrative staff).

Unit	Quantity
Chemistry Science	16
Administrative and economical sciences	39
Hospitality Sciences	6
Engineering	14
Architecture and urbanism	4
Total	79
Distribution by gender	
Women 42 (53%)	
Men 37 (47%)	

Table 4-15**.** Participants in the training sessions.

Evaluation of satisfaction of participants in the training phase

A 10-item Likert scale survey was created (see UCuenca Annex 4) with eight questions, both open and closed, regarding training and confidence in the use of the tool. 21 lecturers completed the survey, and their results indicate that most teaching staff would recommend the training, feel confident that they can start using the tool and know where to go in case of problems. Figure 4- 41 shows these results.

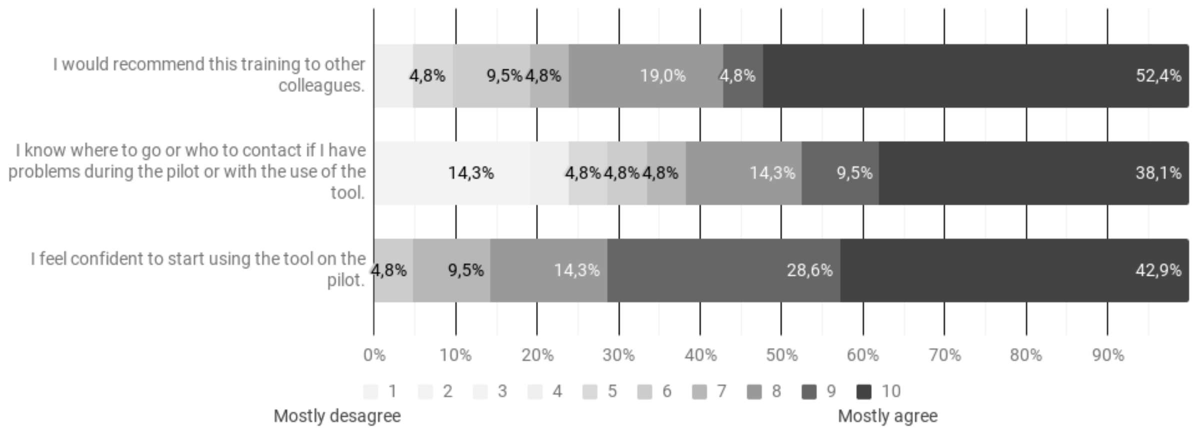

Figure 4- 6. Training satisfaction survey results.

Phase 4: Use Report

Descriptive statistics of use records

The Avac tool has a system that records the actions that users perform on it. According to these usage records, the Academic Counseling Dashboard is being actively used by 48 professors (of the 74 to whom the agreement was delivered) involving 1873 students. This activity is expected to continue to increase, as the necessary changes have been made to AvAc so that other faculties, with a different qualification structure, that were not part of the piloting, can use it. In Figure 4- 42 you can see statistical values in a general way about the piloting carried out, including the total number of teachers who used the tool, the averages of actions carried out, times taken for said actions, as well as an average of the number of students who the teachers reviewed the information, with and without their presence.

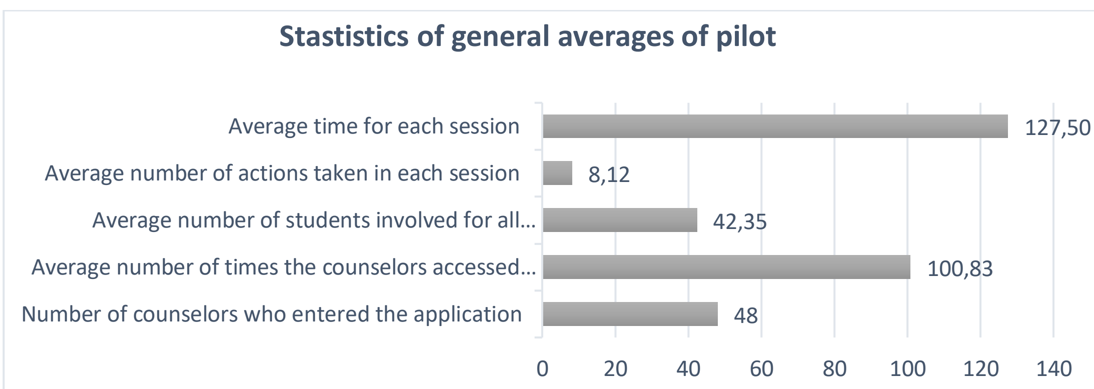

Figure 4- 7. General pilot statistics

In addition, in *Figure 4- 43*, we can observe an average of both period of time and number of times that some of the actions considered most important for the analysis were carried out.

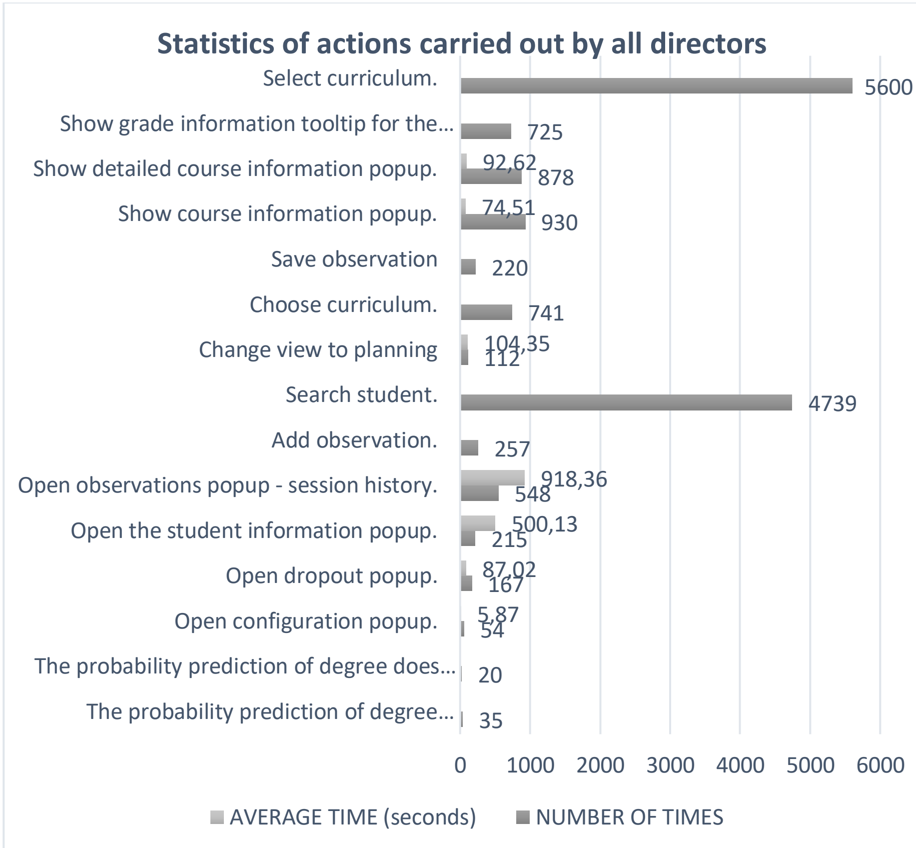

Figure 4- 8. Statistics on actions taken by all counsellors.

The statistics described above correspond to the use made of it by the teaching staff involved in the pilot phase and who have monitored the academic progress of the students who are taking a subject for the second or third time. To this end, the deans were provided with a list of students ordered according to their performance and a guide for the execution of academic counselling (see UCuenca Annex 8). In addition, they were requested to invite students they felt would benefit to attend academic counselling meetings. The data was recorded in logs, which show that 1873 different students have been monitored. 344 of these students were invited to a face-to-face counselling session and 184 attended on their own initiative.

The logs record that a total of 30 counsellors used the "*student's overall academic information*" display within AvAc, i.e., overall averages in terms of passing, failing, or repeating subjects, as well as the student's overall grade point average for the degree. This was performed for a total of 50 students with and without their presence.

In addition, a total of 29 counsellors used the subject planning view for the following semester for a total of 74 students, of which the majority was done without the presence of the student. The maximum time of use of this view was 5 minutes and 49 seconds.

Regarding all the actions that the counsellors have carried out on the counselling tool, both with and without the presence of the student, they stand out, review the information of the subjects, that is, they select the subject and observe the histogram that shows the distribution of students' grades in a course and the location of the analysed student's grade relative to their classmates. As well as detailed information on the subject, which shows the grades in the different contributions (exams, suspension, etc.) and review the general academic information of the student in the interface of "Student Information". According to Figure 4- 35, the action that the counsellors have taken the most is “Choose curriculum”, an action that allows viewing academic information about other curricular networks or careers in which the student has taken a subject. The high number of executions of this action is since at the university there was a process of redesign of careers, which caused many students to have to change the curriculum. From this it can be inferred that AvAc is providing support for academic advisers to analyse the academic situation of the student before they have changed courses.

Only 17 counsellors have also used “add observation to counselling session” functionality involving 185 students (more than one observation for some students). This has taken them between 10 and 17 minutes. Many of these observations indicate why the student repeated or failed a subject, as well as the suggestion that the student was given to attend the next period.

AvAc use and utility survey

In order to collect information on the use or practices supported by the AvAc tool during the counselling process provided by teaching staff to students, each lecturer was requested to ask the student to respond to a survey after using the tool in each counselling session (see UCuenca Annex 5). It consisted of 10 questions regarding the usefulness of the tool. The purpose of this meeting was to obtain feedback from the students and to improve the tool for future piloting and counselling sessions. The first question simply indicates whether or not the student observed the counsellor using the AvAc tool for the session, while the remaining 9 questions indicate the student's perception of the tool. They could select an answer from 1 to 10 for each question, with 1 indicating complete disagreement and 10 indicating complete agreement. The results of these surveys are discussed below.

AvAc use and utility survey results

The analysis of the answers obtained in the survey sheets mentioned above, show that 25 students participated in this evaluation. 22 of the 25 participating students state they saw the AvAc tool on the lecturer's computer at the time of the session. In addition, most (18, answers with scores 9 and 10) say that it was easy to see that they were looking at their academic history in the tool. In addition, students would like to be able to access it from their homes, as 17 of them indicate that this helps them reflect on their academic situation. In *Figure 4-40*, these results can be seen in more detail

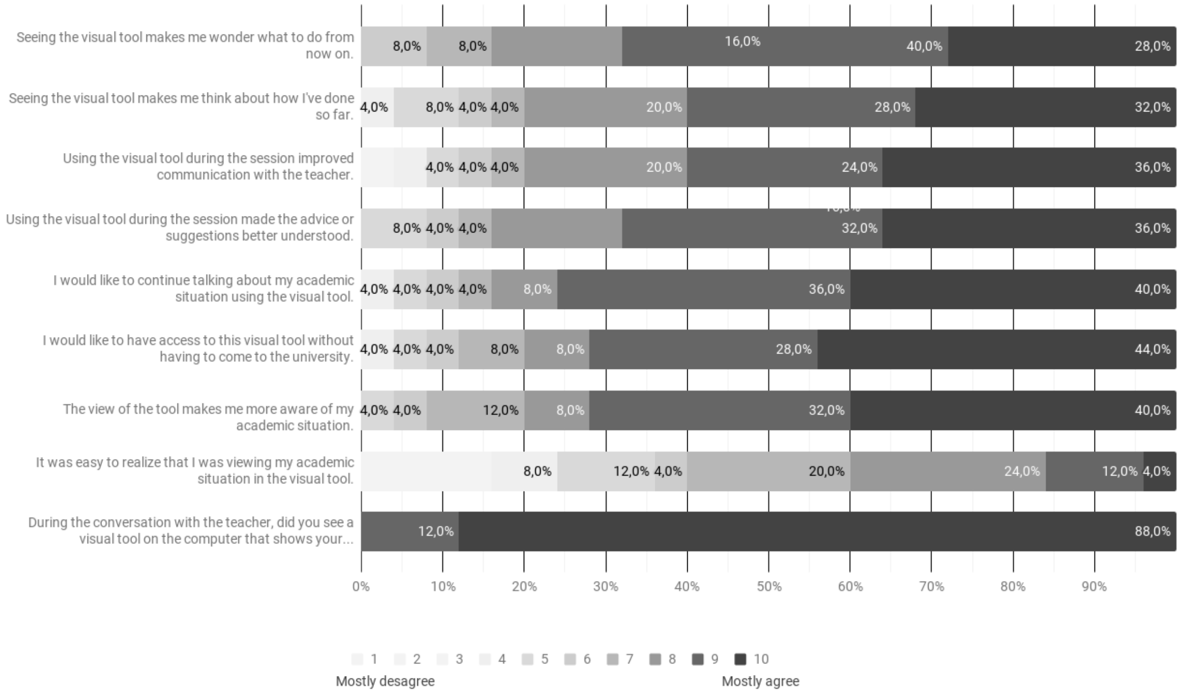

Figure 4- 9.Usefulness survey results.

Impact on student performance results

To verify whether the AvAc tool had a positive influence on academic performance, only academic information from students who attended an academic counselling session supported by AvAc was taken into consideration.

The performance of the 240 students involved in the piloting during the March 2020 period was compared with their performance in the March 2019 and September 2019 periods. All the students included in this analysis belong to one of the races in which the piloting was carried out. This career, prior to registering the subjects for the period of March 2020, invited its students to an academic counselling session supported by AvAc. In the two previous periods, students did not have an academic counselling session prior to registration.

The academic data analysed were: grade averages, subjects taken, subjects failed, and subjects cancelled during the academic period. According to the data in Table 4-31, and based on the academic period March 2020, it is necessary to:

• The average grade obtained by students during March 2020 (where AvAc was used) was higher. Increasing by 6.44% compared to the previous academic period.

• The average percentage of failed subjects in March 2020 with respect to the total of subjects taken was 28.80%, being higher compared to previous academic periods (28.06% and 28.02% respectively).

• The average percentage of subject cancellations was lower than in previous academic periods. However, it shows that even though in the academic counselling sessions students were suggested the subjects to take in the period March 2020, these suggestions were not accepted by the students.

Result of academic counselling			
	Before using AvAc		after AvAc
Description	**March-2019**	**September-2019**	**March -2020**
Calcifications average	70.63	73.76	80.20
Percentage of increase in grades compared to the previous semester	-0.32%	3.13%	6.44%
Average number of subjects taken	5.38	4.92	5.40
Average percentage of failed subjects	28.06%	28.02%	28.80%
Average percentage of subjects cancelled	22.78%	21.33%	19.80%

Table 4-16. Result of the analysis of the academic performance of the students by semesters.

Figure 4- 45 shows these variations in student academic performance by semester.

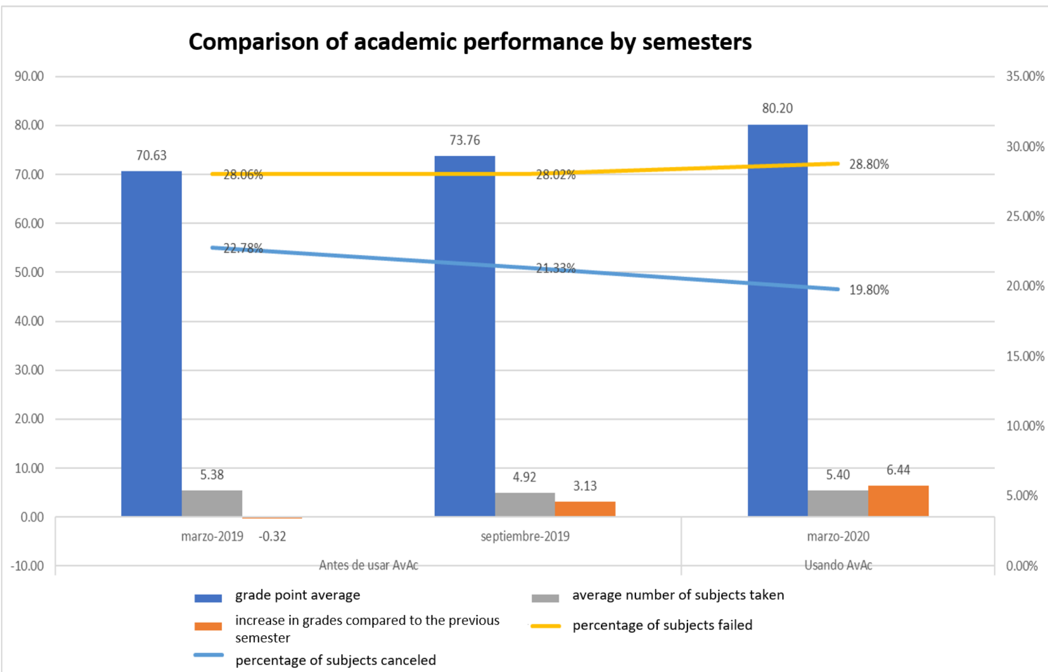

Figure 4- 10. Comparison of academic performance by semesters.

Even though the results do not show a significant impact on the academic performance of the students, especially in the reduction of the percentage of failed subjects, AvAc has been accepted by academic counselors. They have stated that AvAc facilitates their work, and like what was stated by the students, it allows them to have a clear vision of the academic trajectory of the students.

Phase 5: Evaluation and Improvement

According to what was planned, an evaluation of the AvAc tool was carried out to validate its usability (ease of use) through the knowledge acquired by the participants who used it, this was done through surveys (see UCuenca Annex 6), which It resulted in a total of 32 users who responded to the survey, with the majority indicating that they would like to use the system more frequently, which means that the tool is a good support in terms of academics. The following Figure 4-46 shows the responses to the survey by users in detail:

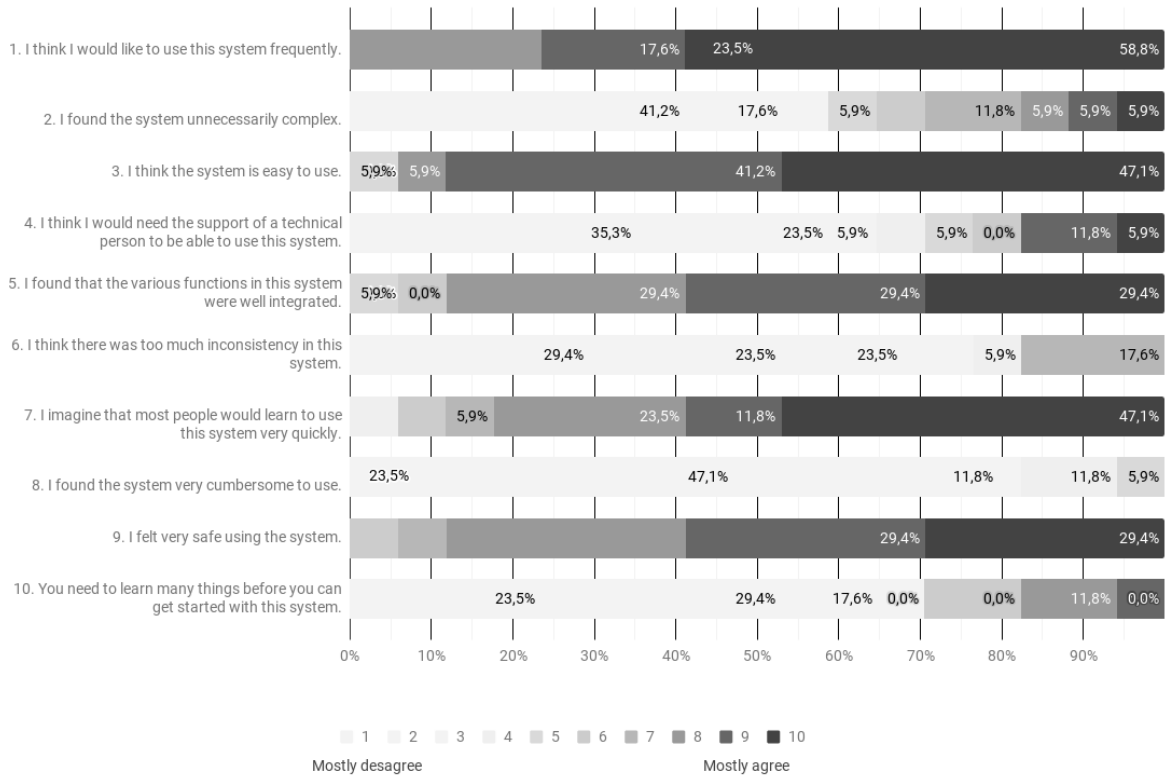

Figure 4-46. Usability survey results.

Post-pilot analysis results

It has been possible to identify some lessons learned during this process. These lessons are listed below and are intended to guide other institutions in their piloting process when adopting AvAc or another LA solution.

With respect to obtaining the support of authorities or internal sponsors for the project, especially in institutions that do not have previous experience with LA, it is important to be able to clearly communicate what is expected from this type of project. Inexperienced institutions may not be clear on either the type of deliverables expected from this type of project, or the applicability of these deliverables. It is important to hold workshops that show examples of tools designed for similar educational contexts, also including processes and results of their application. This is in order to motivate institutions to adopt LA.

With respect to obtaining requirements and designing the visualization tools, it is of great importance that the stakeholders collaborating in the process are not limited to experts in the academic domain, ensuring the participation of technical personnel who work with the institutional databases. In our case, this resulted in an important contribution because not only did we get the commitment of the IT department, but in the process of obtaining information requirements, the existence of data that could provide the required information was quickly and easily identified. In addition, the tools should be socialized early with the authorities of the institution and different faculties/degrees/units to detect possible conflicts with the policies of the institution and different ways to execute the processes depending on the faculty/degree/unit.
With respect to the piloting activities, a careful selection of the participating units should be made as their internal policies, allocation and monitoring mechanisms may be different from one another and therefore affect the performance of the pilots. It is recommended that criteria be defined that will satisfy the units participating in the pilots and to carry out a prior verification of their compliance before committing to them.

4.3.3.2 Dropout Prediction Tool Pilot Project

The dropout prediction tool was designed to alert teaching staff to the possible early dropout of students. This alert is intended to enable the lecturer to detect the possible reasons for each student dropping out and to intervene in time to prevent possible dropouts. Like the AvAc tool, the dropout prediction tool is used before the beginning of each semester, when all students must attend counselling sessions, and in the middle of each semester, when only students with low averages must attend counselling sessions.

The visualizations for the dropout prediction tool were developed using two different technologies for the frontend. The first technology used is ReactJS, a framework that allows writing both html and JavaScript code together using typescript, facilitating the creation and design of complex components; and the second technology used is D3JS, which is a library that, besides allowing manipulation of the DOM in real time, allows the design of graphics of any kind in svg format, providing functions that facilitate each of these tasks. For the backend, NodeJS technology was used with an implementation of two layers of abstraction: the model and the controller (sequelize), together with the configuration files for the connection to the database. In addition, a REST API was created for database access. To analyse the data generated by the visualization of the risk of degree dropout, instructions were included in the dashboard code that enable a feed to a log with all the actions performed by the counsellor (click, mouse over, mouse out, etc.), and additional information (subject, visualization, student, counsellor, etc.). Lastly, in the frontend, a file in json format was included, which contains all the texts that explain in detail each of the variables shown in the display of the dropout risk utility when the cursor is moved over these variables.

The processing of the academic data and its analysis, the creation of the models, and the prediction algorithms were programmed in the Python programming language and using libraries such as Pandas and the free software from the Scikit-learn library. This open-source library implements many machine learning algorithms with which the different predictive models were made. Different tests were done with the following algorithms: Random Forest, Decision Tree, Support Vector Machine (SVM), Multi-Layer Perceptron (MLP) and Gradient Boosting among others.

Resources

This section describes the project resources for the piloting of the dropout prediction tool.

- Project coordinator: 1
- Support group: 2
- Infrastructure: 2 servers
- Collaboration with UC3M for the development of the prediction algorithms
- Users involved in Academic Counselling: 4 program directors, 16 academic committee members or faculty, 2 administrative staff, and 290 students
- Users involved in the Evaluation Activities by Subject Results: 40 lecturers and 500 students indirectly

Methodology and planning

The steps followed are the same as for the counselling tool. Table 4-32 shows the phases, activities, dates, methodologies, efforts and artefacts for the execution of the pilot project.

Phase	Activity	Start date	Termination date	Methodology
Preparation	Tool development	25-11-2018	22-10-2019	Preparation of the necessary data Development of the tool Refining tool use log
	Socialization of the pilot plan with stakeholders	15 July 2019	20 July 2019	Preparation of LALA Project Presentation and Academic Counselling Unit Proposal Presentation of the characteristics and use of the UCuenca Dropout Prediction Tool. Adaptation of perception surveys and work on the special application process for subject enrolment and withdrawal (UACH originals)
Agreement	Agreement with participants	20 July 2019	20 July 2019	(Same phase as with the counselling tool) Adaptation of informed consent (UACH originals)
Dissemination	Raising interest in other faculties and engaging faculty. Several sessions were required to identify people prepared to commit	15 July 2019	29 July 2019	Adaptation of the presentation of the features and use of the Counselling Tool Use of the Academic Counselling Tool with real data Note: Initially this phase was conceived as training but there was scepticism regarding the use of the tool and the process.
Training	Training for users	20 Sept 2019	2 Dec 2019	(Same phase as with the counselling tool) Use of the Academic Counselling Tool with real data Knowledge test Pre-test questions (teaching staff) Guide for Academic Counsellors UCuenca Academic Attendance List
	Training for administrators	4 April 2019	4 April 2019	Meetings with the system administrator

Use	Monitoring of activities	22 April 2019 13 September	3 May 2019 20 September 2019	SUS (System Usability Scale) Knowledge test Google Analytics
Evaluation and Improvement	Evaluation	7 May 2020	31 May 2020	Post-test questions (teaching staff)
	General evaluation	18 April 2020 23 April 2020	18 April 2020 23 April 2020	Meeting minutes /emails
	Documentation of improvements (related to training)	29 April 2020	29 April 2020	Report to the Academic Vice-Chancellor
	Analysis and documentation of improvements (in relation to use)	21 Ma 2020	3 September 2020	Report to the Academic Vice-Chancellor

Table 4-32. Pilot planning

Phase 1: Preparation

Processes included in the pilot project

In the case of the dropout prediction tool, this report is shared with the AvAc tool and can be found under Phase 1: Counselling Tool Baseline Report.

The prototypes generated by other partner institutions were used as materials for the focus groups explained in the previous point. In particular, the prototype made by ESPOL was used as a starting point. As a result of the design, high-fidelity prototypes of the dropout prediction visualization were obtained.

The high-fidelity prototypes served as input for building the corresponding Beta versions. We proceeded to disseminate the academic counselling tool in faculties (three) that did not participate in the design (Chemical Sciences, Economic and Administrative Sciences, and Hospitality Sciences) with the aim of gaining their commitment to participate in the pilot phase, receiving feedback to improve it. During these sessions, participants analysed the real academic records of students in their degrees.

Baseline

As in the previous section, the baseline of the dropout prediction tool was drawn up according to the AvAc tool. All the information can be found under Phase 1: Baseline report in the Baseline section.

Phase 2: Agreements

The visualization of the dropout prediction tool is integrated in the counselling dashboards so the agreement report is the same as for the other tools and can be found under Phase 2: Counselling Tool Agreement Report.

Phase 3: Training

The training for the prediction tool took place at the same time as the AvAc tool and the process followed can be seen in the section Phase 3: AvAc Tool Training Report.

Phase 4: Use and Impact

Descriptive statistics of use records

According to the information obtained in the logs during the pilots carried out on the dropout prediction tool, the following information has been obtained:

Action	Number of Teaching staff	Number of Students
Able to use the tool	74	
Making use of the AvAc tool	48	1873*
Going to counselling	25	344**
Asking for advice	19***	184
Making use of the dropout prediction tool	48	135

Table 4-17. Number of actions in the tool

*Students analysed with or without their presence in counselling.

** Includes students who were invited to a counselling session and students who requested a session.

***Number of counsellors who have received requests for counselling

As can be seen in Table 4-33, out of a total of 1874 students only 135 have received counselling based on the results of predicted dropout. These results are largely since in the last larger pilots carried out the dropout prediction could not be available for the new faculties, but it represents a significant improvement with respect to the previous pilots, in which it had to only 13 teachers reviewed the dropout prediction for just 18 students.

Even so, in all cases where students decided to go to counselling sessions of their own free will, before the session lecturers made use of the dropout prediction tool to prepare their observations and advice for these students and to recommend the subjects they should take in the following period.

A total of 48 counsellors were interested in checking the student's overall academic information, i.e., overall averages in terms of passing, failing, or repeating subjects, as well as the student's overall grade point average for the degree. This was performed for a total of 1873 students with and without their presence.

In addition, of these 74 counsellors, as mentioned above, the 48 observed the risk of dropping out of the students without their presence, and, according to the analysis carried out in the logs, the maximum time that one of these counsellors was analysing the risk of dropping out of a student is 4 minutes and 38 seconds. It could be deduced that he or the student has a fairly high risk of dropping out of the career and therefore, the teacher had to carefully analyse each of the variables for which the student presents that percentage of risk of dropping out of the course. career.

Based on the tool's use logs, it has been concluded that most counsellors carried out a careful review of the student's academic status through the student's curriculum, focusing on the grades he/she had obtained in each of the subjects and those of his/her classmates, as well as the subjects the student failed. In addition, they continued to review the student's academic progress after reviewing the dropout rate.

Also, according to the logs obtained from the tool, there has been an increase in the use of the dropout risk tool (figure 4-47), which means that decision makers give importance to the student's grade probability to provide the necessary advice the same.

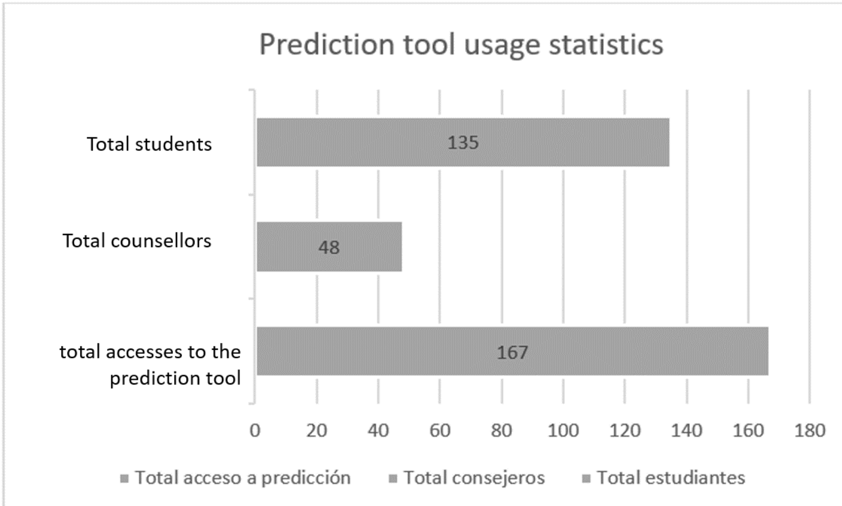

Figure *4-47.* Results of the use of the dropout risk tool.

In addition, according to the feedback from users on whether or not they agree with the prediction they see (figure 4-48), we can conclude that the prediction still needs to be improved, since, although the majority indicate that they agree with the prediction about the student that you are analysing, there is a high number of users who indicate that they do not agree, therefore, it is necessary to review the cases in which users do not agree, based on this, to find a solution.

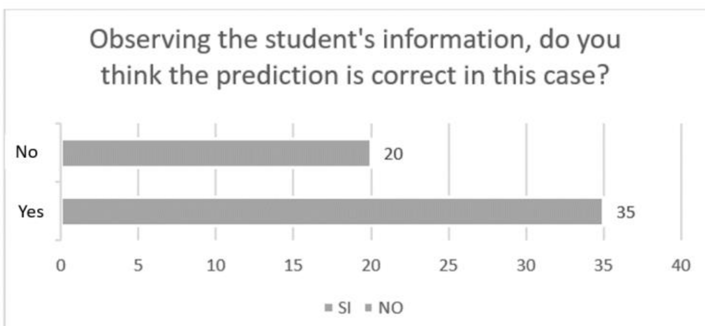

Figure 4- *48.* Feedback results for the dropout risk tool.

Academic counseling sessions will continue once the intermediate and final grades for each semester are available in order to increase teacher and student participation.

Phase 5: Evaluation and Improvement

After conducting the training phase for counsellors, some suggestions were received regarding the tool in a first attempt to improve the tool and its visualization. After collecting these suggestions, a first modification of the dashboard was made and more data was included, such as the variables used for the calculation of the probability of dropout, and some explanations regarding these.

Because a high level of probability of dropout (close to 100%) caused alarm in teaching staff, it was decided to limit this probability to a maximum of 90%. However, at the University of Cuenca, the data used for predicting university dropout only refers to student academic performance, since no other type of data is yet available. For this reason, depending on the socio-economic situation or the behaviour of the student in the face of setbacks during their degree, the probability of dropping out may differ from that provided. Therefore, it was decided to provide a warning message to the counsellors before showing the probability of dropout of those students with a high probability. The message shown is as follows:

"The probability of dropping out has been calculated solely by using academic data pertaining to the student's curriculum path. The student's socio-economic and personal data have not been considered, so the probability of dropout may be lower than that shown below."

Another modification made to the preliminary version was the incorporation of the prediction algorithm's hit rate. It was necessary to provide this information to the counsellors so that they could observe the probability of success of the algorithm, and although it is not possible to offer an algorithm reliability for each student, it was decided to offer the success rate of the algorithm by the student's degree and current semester.

The survey, together with the use logs, allowed for a more extensive analysis of the tool and the usefulness and impact it has had on the institution. In addition, this analysis served to further improve the visualization, explanations, and prediction models.

4.3.4. Pilot Projects at Escuela Superior del Litoral (ESPOL)

4.3.4.1 SiCa Counselling Tool Pilot Project

The SiCa counselling tool allows teaching staff to give recommendations to students regarding which subjects to take in the new semester.
The tool aims to improve the existing process and institutional counselling tool by means of three new visualizations based on academic, personal, psychological and other data. This tool is used before the beginning of each semester (all students must attend counselling sessions), and in the middle of the semester (only students with low averages must attend).
The tool was developed using NodeJS technologies with an implementation of two layers of abstraction: the model and the controller, together with configuration files for database connection and information needed for connection to the authorization server. However, the implementation of an API implies that a security and authentication protocol is in place to prevent unauthorized applications or users from accessing the data. For this purpose, the use of the OAuth 8 2.0 protocol was chosen, which defines the flow of authorization protocols according to the implementation design of the application, thus allowing access to data in a secure manner. It was decided to create a REST API for the consumption and loading of data from the main application. Google Analytics is used to analyse the data generated by the tool.

Resources

The resources used for the execution of the pilot project were as follows:

- Server to host the tool
- Computer technician for service support (tool availability)
- Project researchers for data collection and analysis
- Pilot team
    - Project Coordinator
    - Specialists in technological infrastructure
    - Group for training, pilot project support and monitoring
- Participants. The target audiences to be reached within the university are:
  End users: ESPOL teaching staff who have counselling responsibilities, and undergraduate students in all degrees and levels.

Planning

Table 4-34 shows the phases, activities, dates, methodologies, efforts and artefacts for the execution of the pilot project.

Phase	Activity	Start date	End date	Methodology
Preparation	Artefact development	March 2019	April 2019	Artefact development
Agreement	Agreement with the participants	April 2019	April 2019	Project meeting
Training	Training for users	April 2019	April 2019	Training workshop for users
	Training for administrators	April 2019	April 2019	Training workshop for administrators
Use	Monitoring of activities	April 2019 and 2020 September 2019	May 2019 and 2020 September 2019	Online activity analysis
Evaluation and Improvement	Evaluation	May 2019	May 2019	Filling out a Likert survey
	General evaluation	18 April 23 April 2019 09 January 2020	18 April 23 April 2019 09 January 2020	Meeting with Vice Chancellor, Student Welfare, Undergraduate Office, GSTI
	Documentation of improvements (in relation to training)	29 April 2019	29 April 2019	Documentation of improvements
	Analysis and documentation of improvements (in relation to use)	21 May 2019	3 September, 2019	Documentation of improvements

Table 4-34. SiCa counselling pilot planning

A description follows of the development and results obtained after carrying out each of the activities in the phases mentioned in Table 4-34.

Phase 1: Preparation

Processes included in the pilot project

Since ESPOL already has a process and a system for academic counselling, the pilot focused on analyzing how the implementation of new visualizations in the system affects the use and acceptance by the faculty advisors, as well as comparing its impact against the last semester where these new visualizations did not exist.

Current situation of processes included

At ESPOL, academic counselling is provided using a system in place since 2013 with the objective of: "Supporting students in their overall educational process, detecting their academic strengths and needs, providing effective solutions, through timely and appropriate support by the Academic Counsellors. This support and monitoring process is carried out from the student's admission through to graduation." Counselling takes place twice during each semester: one week before enrolment and the week following the first evaluation (mid-semester). Each session lasts 15 minutes.

In 2017 and 2018 a needs assessment was carried out in relation to learning analytics at ESPOL as part of the LALA project. The result showed the need to improve the current counselling system. After the technical requirements survey that involved approximately 40 lecturers in an iterative process for designing the tool, 3 new visualization windows were developed.

Utility and impact baseline

To evaluate the usefulness of the visualizations, the baseline was created using a survey with a closed and an open question. In addition, an analysis of the academic situation of the students who come to the counselling centers was carried out for the evaluation of the students' performance.

The current indicators of the aspects to be evaluated in the pilot project are the following:

1. **Counsellors' perception of the 2018 counselling system:**
   175 lecturers out of 341 completed a Likert scale question ranging from 1 (strongly disagree) to 5 (strongly agree) regarding their satisfaction with the current counselling tool. The answer was qualitatively sound.
   a. The wording of the question was: “The information (e.g. tables, graphs) currently provided by the counselling system is sufficient to make sound decisions to guide the student”

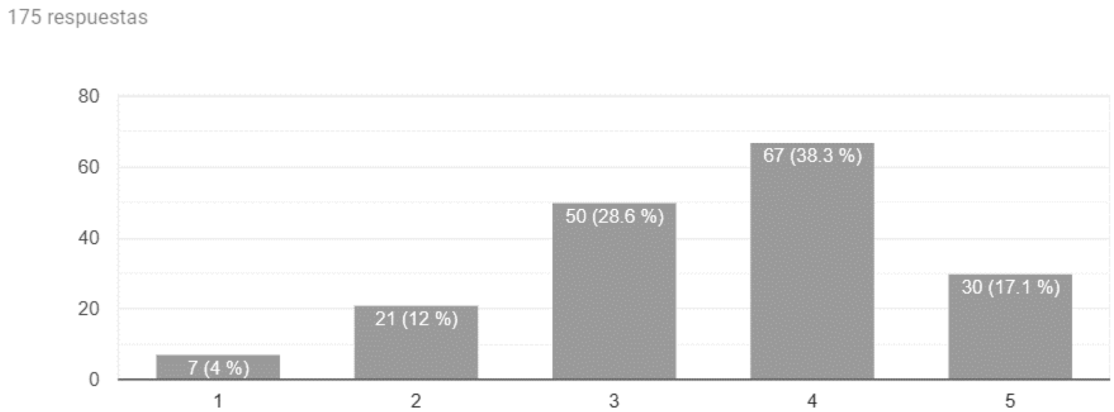

Figure 4- 11. Pre-test results

In *Figure 4- 49* it can be seen from the variety of responses that satisfaction with the current counselling system is not complete. The percentage of "strongly disagree" to "neither agree nor disagree" (44%) is higher than "strongly agree" (17%). The following are some comments on why the dissatisfaction is occurring.

"Sometimes you have to check the academic system because not all the information is up to date in the counselling system."

"It is difficult to interpret and relate to the data presented by the student and the information available on the platform."

"The tables are not so user friendly. You can't just quickly look at subjects passed and grades in previous years, you have to enter another section in the system."

"The information is usually very generic, and often does not fit the student's situation."

2. **Academic Average:** Additionally, the students' academic average was obtained in the first semester of 2018 before the new visualizations were incorporated. The average grade for students who received counselling was 7.60 while for those who received counselling it was 7.72.

Phase 2: Agreements

Description of the pilot population

A total of 152 trained lecturers signed the consent agreement. The agreement was distributed to the teaching staff electronically (see ESPOL Annex 1) and was signed in the same way. The agreement mentions what use will be given to their data during and after the training and who will have access to it. *Table 4-35* shows the participants.

Because the counselling process already existed at ESPOL, the new visualizations were made available to all counsellors. As will be seen below, the tool has also been used by other counsellors who did not sign the agreement or attend training.

Department	Number
Faculty of mecanical engineering and Production Sciences	17
Faculty of Social Science and Humanity	25
Faculty of Electrical Engineering and Computer Science	34
Faculty of Maritime Engineering and Marine Sciences	7
Faculty of Natural Sciences and Mathematics	26
Faculty of Engineering in Earth Sciences	12
Faculty of Art, Design and Audiovisual Communication	18
Faculty of Life Sciences	12
Library Information Center	1
Total	152

Distribution by gender	**Distribution by role**
Female 59 (39%)	Administrative 1 (1%)
Male 93 (61%)	Conselor 134 (88%)
	Coordinator 17 (11%)

Table 4-18. Results of the participants.

Phase 3: Training

Description of the training phase

Sixteen training workshops were held. These were held between 9 and 12 April. The goal of the workshops was to provide instruction that would allow ESPOL teaching staff to understand how the SiCa tool supports the process of selecting subjects for students through the new visualizations developed.

The following activities were carried out during the training:

Activity 1

- Trainer's explanation of the visualizations, referring to the LALA project.

Activity 2

- The lecturers completed a knowledge test to see if they had learned how to use the tool.

Activity 3

- The lecturers completed a satisfaction survey based on the System Usability Scale (SUS) questionnaire.

Description of participants in the training phase

The workshops brought together a total of 187 teaching staff, and Table 4-36 describes the participants:

Unidad	Cantidad
Faculty of mecanical engineering and Production Sciences	24
Faculty of Social Science and Humanity	28
Faculty of Electrical Engineering and Computer Science	43
Faculty of Maritime Engineering and Marine Sciences	7
Faculty of Natural Sciences and Mathematics	34
Faculty of Engineering in Earth Sciences	16

Faculty of Art, Design and Audiovisual Communication	21
Faculty of Life Sciences	13
Library Information Center	1
Total	**187**
Distribution by gender	
Men 115 (61%)	
Women 72 (39%)	
Distribution by role	
Administrative 2 (1%)	
Academic counsellor 166 (89%)	
Degree coordinator 19 (10%)	

Table 4-19. Participants of the training sessions

Evaluation of satisfaction of participants in the training phase

To ascertain each participant's assessment of the training, a satisfaction survey was carried out in an online format (see ESPOL Annex 4). It consisted of 10 items for which satisfaction was evaluated from 1 to 5 in relation to the new visualizations (sections) within the counselling system. 183 lecturers completed the survey. The results indicate that most lecturers find the modules implemented easy to navigate, access and visualize.

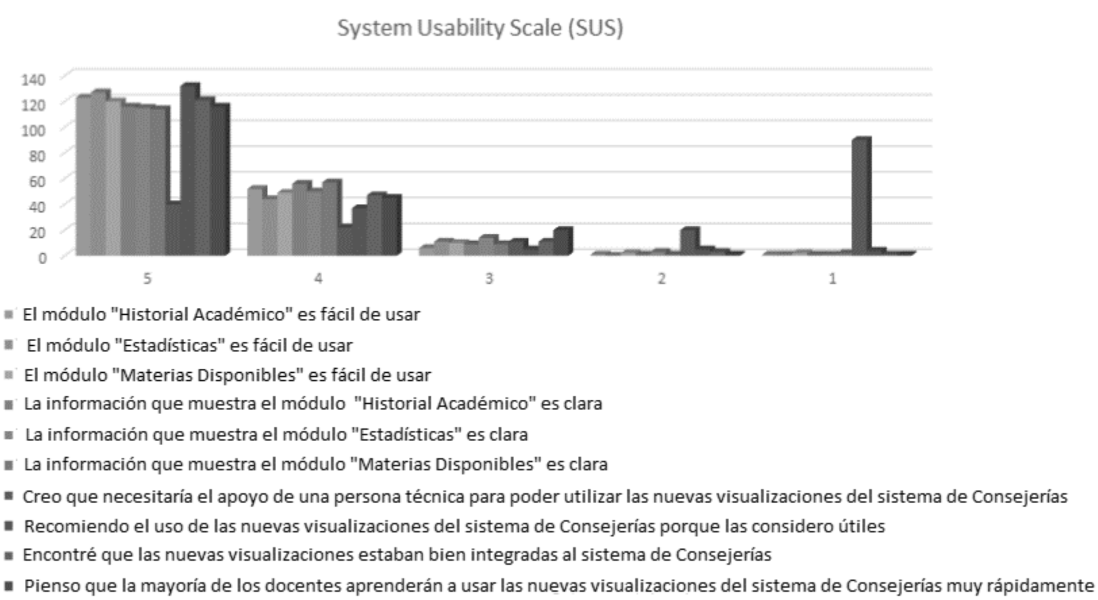

Figure 4- 50. Satisfaction with the usability scale (SUS) results

An open question was also added for comments on system improvements. Among the comments, the following stand out:

“Internship hours should automatically appear and not have to be logged by the user."

“It would be good to make some educational videos about the use of the platform."

“Counselling offices should not be closed; they have to be open so that we can counsel students throughout the semester without interruption.”

“Have a report automatically generated at the end of the counselling for all students with statistics to help visualize their use.”

Evaluation of learning achievement of participants in training phase

To evaluate learning achievement, participants were asked to solve an open-ended 3-item test where they were assessed on their use of the tool. An example of an item was "Statistics window": How many subjects that were not suggested by the counsellor, were taken by Juan during the 2017-2S semester? (See ESPOL Annex 3). It can be seen from Figure 4- 51 that most lecturers answered the 3 items correctly. This enabled us to confirm the usability "learning" principle in the area of interaction. In other words, we measured that the lecturers remembered where the functionalities of the new tool were.

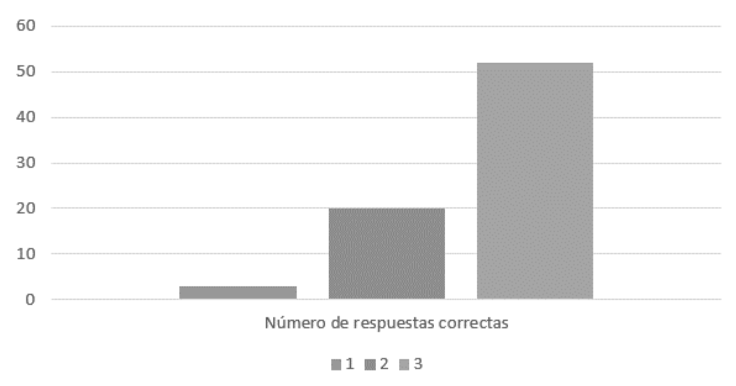

Figure 4- 12. Knowledge test results

Phase 4: Use and Impact Report

Descriptive statistics of use records

TThe SiCa tool has a system that records the actions performed by users on it. Statistics show that users have been actively involved, and this is reflected in the 287 lecturers who have consulted the new visualizations at least once the tool, which impacted 3655 students during the first semester 2019, and 151 lecturers during the second semester2019, which impacted 532 students.

In relation to 2020, there is a change. 3 modules from the "Statistics" window were added to the main window of the system (Academic evolution, Wellbeing monitoring, and the retention module). Due to this, an increase in accesses to the new visualizations is reported since all teachers must see the main window. Thus, this equates to 297 teachers (3,822 students) who gave counseling in the first semester of 2020 and 292 teachers (2906 students) who gave counseling in the second semester.

Stripping out the number of lecturers and students who repeat, the final numbers show that, **between the first and second semesters of 2019 and 2020, 416 lecturers accessed the new visualizations, representing 9485 students**. In table 4- 37, the results are broken down by lecturers and students involved:

Type of use	Teachers	Students	Period
Counselling in general	315	7714	2019 1S
Used all 3 windows	177	1035	2019 1S
Used 2 out of 3 windows	250	2201	2019 1S
Used 1 out of 3 windows	287	3655	2019 1S
Counselling in general	322	4850	2019 2S
Used all 3 windows	91	227	2019 2S
Used 2 out of 3 windows	132	416	2019 2S
Used 1 out of 3 windows	151	532	2019 2S
Counselling in general	297	3822	2020 1S
Used all 2 windows	102	500	2020 1S
Used 1 of the windows	249	2736	2020 1S
Counselling in general	292	2907	2020 2S
Used all 2 windows	108	627	2020 2S
Used 1 of the windows	250	2492	2020 2S

Table 4-20. Results of the use of the tool.

As mentioned, the counsellors used the visualization of Available Subjects most, followed by Academic Records, and the least used was the visualization of Statistics (10.60%); the same use trend is shown during the second semester of 2019 and 2020.

Figure 4-52, 4-53 and 4-54 describe the access number to the different windows in the different semesters that the piloting lasted. Once again it is reiterated that the values fall in 2020 in all the views due to the context of the pandemic. The counseling was optional because not all students had access to the internet to have a counseling session during a synchronous video conference session

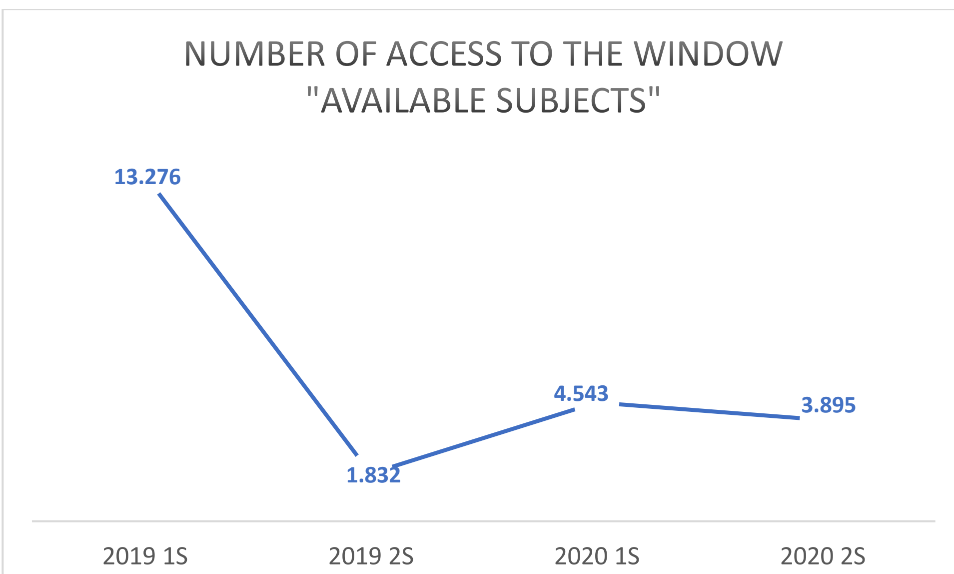

Figure 4- *132*. Number of access to the Available subjects window

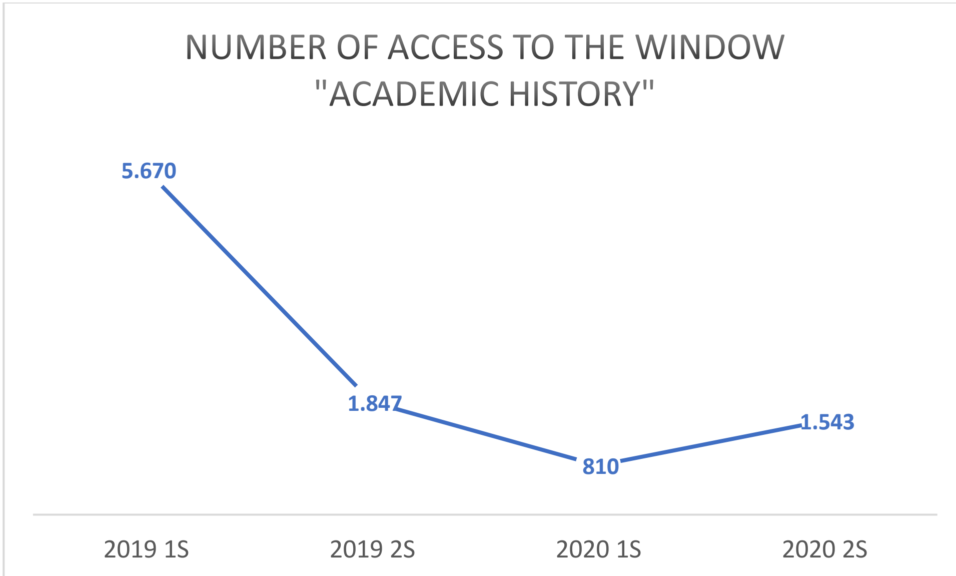

Figure 4- *53*. Number of access to the Academic history window

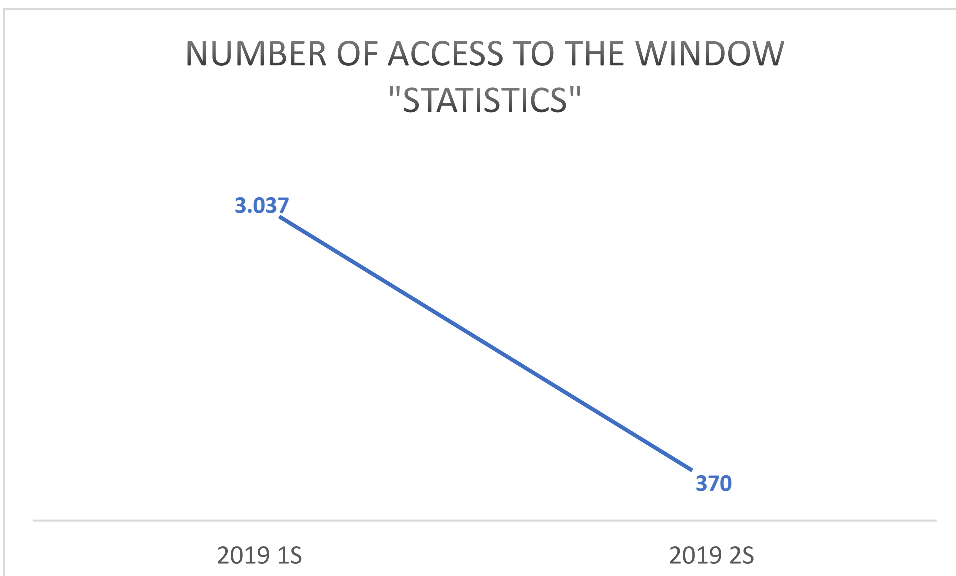

Figure 4- *14*. Number of access to the Statistics window

SiCa use, utility and impact survey

In order to collect information on the use of the SiCa tool during the training, a post-test survey was conducted for which 128 lecturers completed the question: “The information (e.g. tables, graphs) currently provided by the counselling system is sufficient to make sound decisions to guide the student" with a Likert scale between 1 and 5 on satisfaction with the new visualizations (see ESPOL Annex 2). The answer is qualitatively sound, and its results are discussed below.

SiCa use and utility survey results

It can be observed that most of the comments focus on a high degree of satisfaction with the use of the counselling system due to the new visualizations (figure 4-55).

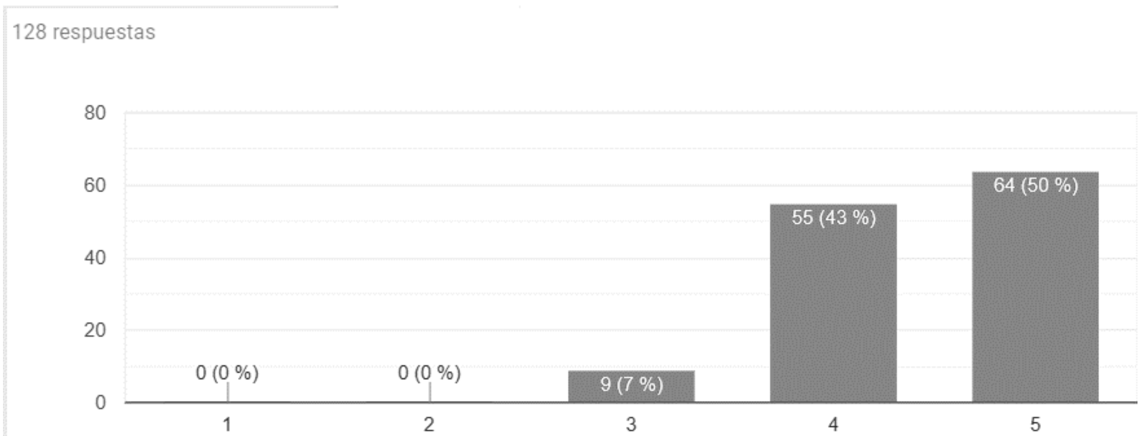

Figure 4- 15. Post-test satisfaction survey results

Among the qualitative comments, the following stand out:
“The student's information and academic record is very complete."
"The information is clear and better organized.”
“The charts allow me to better orient students in the subjects to be registered."
“The information you have is pertinent to good counselling of students."

The following figure 4-56 shows the comparison between the initial and final evaluation of the tool's satisfaction survey.

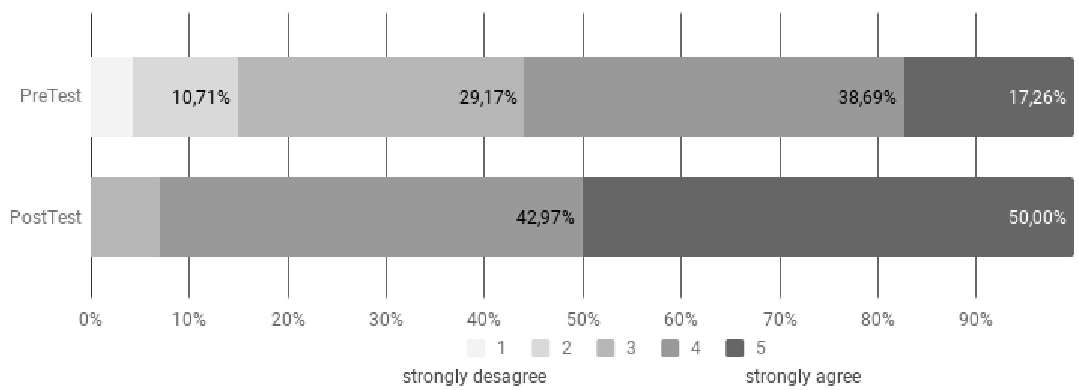

Figure 4- *16***.** Pre-post-test satisfaction survey results

Impact results (time spent on new visualizations vs. lecturer satisfaction on visualizations)

As can be seen in *Figure 4- 57*, according to the Likert scale from 1 to 5, those lecturers who scored that they were most satisfied with the new visualizations in the post-test were those who used it the most (on average 6 minutes), compared to those who scored the lowest (on average 2.5 to 4.5). This indicates a direct relationship between use and time spent.

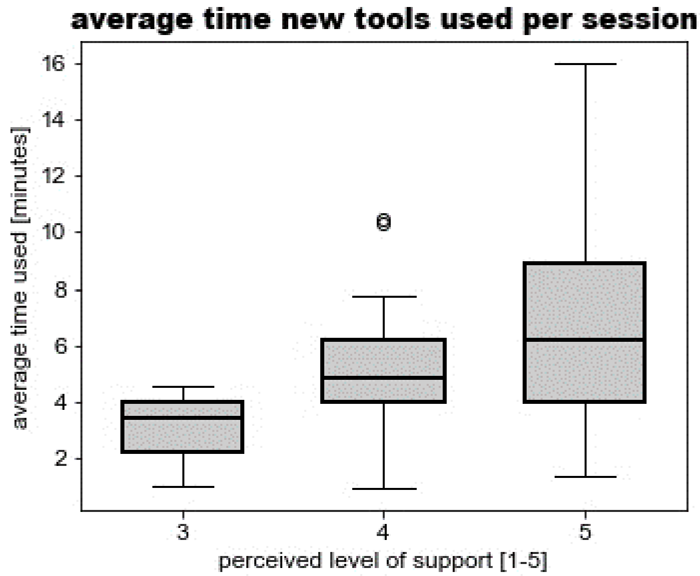

Figure 4- 17. Average time spent by lecturers according to the satisfaction scale.

Impact on student performance results

The students' academic average was obtained in the first semester of 2019 when the new visualizations were incorporated. The average grade for students who received counselling was 7.63 while for those who received counselling it was 7.67.

In *Figure 4- 58*, we can see the difference between the academic average in 2018 (first and second semester) when the new visualizations were not in place vs. 2019 (first and second semester) when they were already incorporated. There is an improvement, although not significant, in the average grade of students who received counselling in 2019.

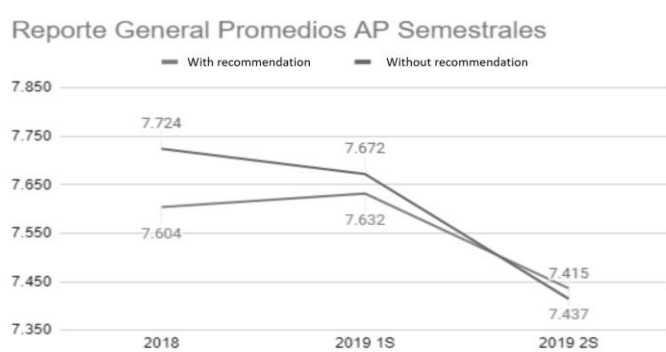

Figure 4-58. 2018 average academic results vs. 2019

Results of the impact on the workload between the suggested subjects and the subjects taken by students in 2018 and 2019

Figure 4- 59 shows that in 2019 both in the first semester and in the second semester with the new visualizations, students began to listen more to their counsellor, because the averages are closer, compared to 2018 when there were no new visualizations. This indicates that, at the student level, the counselling using the new visualizations did have a positive effect, leading them to pay more attention to the recommendations.

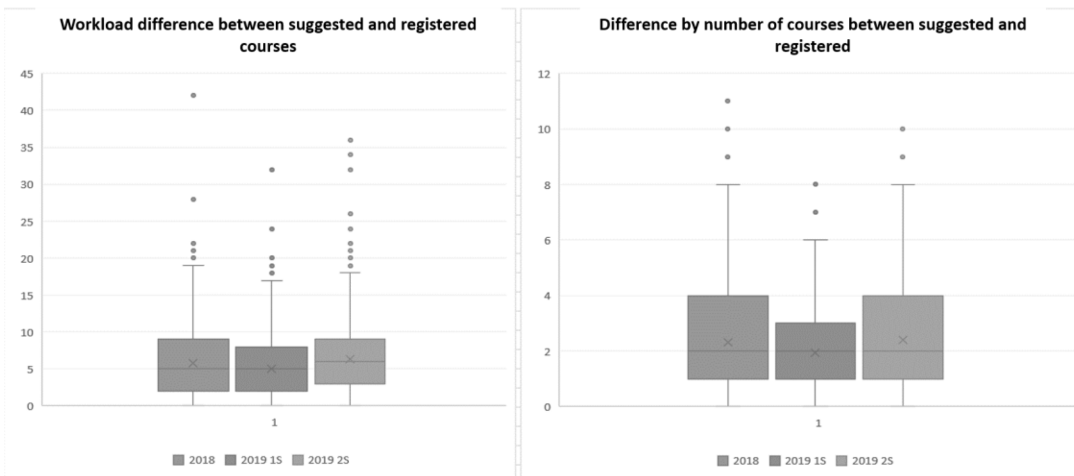

Figure 4- *59* Results of impact on workload 2018 vs. 2019

Phase 5: Evaluation and Improvement

Description of evaluation and improvement

To determine the aspects requiring improvement, the information gathered during the pilot has been analysed, that is to say:

- Post-training evaluation: Based on the oral and written feedback (SUS) that the teaching staff mentioned in the training sessions, a first improvement report was made to present to the competent authority (Academic Vice-Chancellor's Office).
- Evaluation at the end of the semester: Based on the pre-post test results and logs, an improvement report will be made to present to the competent authority (Academic Vice-Chancellor's Office). This report is currently being written.

SiCa utility results

The analysis of the data collected is shown in *Figure 4- 60* Here it can be seen that most of the comments focus on a high degree of satisfaction with the use of the counselling system because of the new visualizations. This is more evident when compared to the initial assessment.

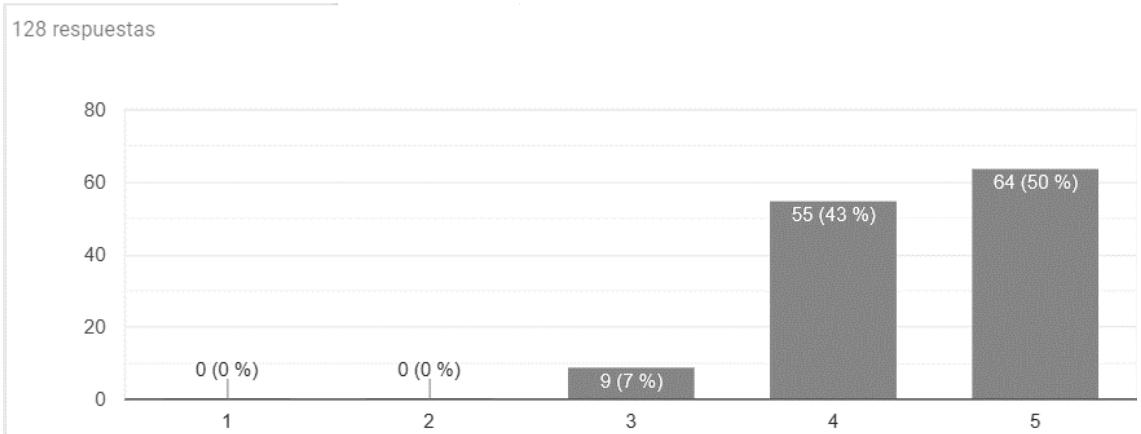

Figure 4- 60. SiCa use by lecturers

Based on the written feedback (SUS) and the post-test, an improvement report was made to present to the competent authority (Academic Vice-Chancellor's Office).
Among the main improvements, the following were mentioned:

- Change the colours of the bars in the degree comparison chart.
- Indicate additionally the number of students per cohort and all students.
- Indicate the level of the subject on the mouseover of the "subjects available" combo.
- Add the credits to the subject and have this displayed when the mouse passes over the subjects and in the total weekly workload.
- Automatic generation of the internship hourly workload.
- Display UBEP (Polytechnic Welfare Unit) information not only when the counsellor refers the case, but also when the student goes on his/her own. This change will depend on the Director of UBEP.
- Indicate what the counsellor sends in the email when referring to UBEP.

Summary of improvement proposals

Given the approval of the reports presented to the Vice-Chancellor's Office, the system will be improved in relation to visualizations and additional information for the term 2020 - 1S. These improvements include moving the "statistics" window modules to different parts of the system because the logs showed few visits.

Post-pilot analysis results

The pilot experience left the following lessons learned, which we believe should be taken into consideration when implementing LA tools in Higher Education institutions.
1.- Institutional support: The whole piloting process will flow as long as you have the support of the institutional leaders. In our particular case, it was more manageable, for example, to plan the training of the lecturers with the approval of the Academic Vice Chancellor. The centre in charge of teacher training was asked to handle all the logistics of convening the teaching staff, choosing the location, advertising the event, among others. As researchers, we only focused on providing the training.

2.- Prior preparation: It is extremely important to plan in advance what you want to measure with the pilot: usability? Acceptance of the system? The instruments to be developed will depend on this. The guide developed by the university coordinating the piloting stage (UACh), helped to ensure clear guidelines of what to do before, during and after the pilot.
3.- Involve technical staff: It is necessary to have personnel who know how to visualize the information from academic databases, logs, and surveys. That way you can "see" the impact the pilot has had and make changes if necessary.
4.- Work in progress: We must be aware that a system can always be improved. That is why constant changes in system improvement must be taken into consideration, based on the feedback received from the system's users. In our case, the qualitative feedback helped to identify what we need to improve in the system in order to present it in the new 2020 version.

4.3.4.2 Dropout Prediction Tool Pilot Project

The dropout prediction tool in ESPOL was designed to alert teaching staff to the possible early dropout of students. This alert is intended to enable the lecturer to detect the possible reasons for each student dropping out and to intervene in time to prevent possible dropouts. Like the counselling visualization tool, the dropout prediction tool is used before the beginning of each semester, when all students must attend counselling sessions, and in the middle of each semester, when only students with low averages must attend counselling sessions.

The visualizations of the dropout prediction tool were developed using two different technologies for the frontend. The first technology used is ReactJS, a framework that allows writing both html and JavaScript code together using typescript, facilitating the creation and design of complex components; and the second technology used is D3JS, which is a library that, besides allowing manipulation of the DOM in real time, allows the design of graphics of any kind in svg format, providing functions that facilitate each of these tasks. Regarding the backend, NodeJS technology was used with an implementation of two layers of abstraction: the model and the controller (sequelize), together with the configuration files for the connection to the database. In addition, a REST API was created for database access. To analyse the data generated by the visualization of the risk of degree dropout, instructions were included in the dashboard code that enable a feed to a log with all the actions performed by the counsellor (click, mouse-over, mouse-out, etc.), and additional information (subject, visualization, student, counsellor, etc.).

The processing of the academic data and its analysis, the creation of the models, and the prediction algorithms were programmed in the Python programming language and through the use of libraries such as Pandas and the free software from the Scikit-learn library. This open source library implements many machine learning algorithms with which the different predictive models were made. Different tests were done with the following algorithms: Random Forest, Decision Tree, Support Vector Machine (SVM), Multi-Layer Perceptron (MLP) and Gradient Boosting among others. For the current version of the prediction model, the Random Forest algorithm was used since it is the one that provided the best results.

Resources

This section describes the project resources for the piloting of the dropout prediction tool.

- Server to host the tool

- Computer technician for service support (tool availability)
- Project researchers for data collection and analysis
- Collaboration with UC3M for the development of the prediction algorithms
- Pilot team
    - Project Coordinator
    - **Specialists in technological infrastructure**
    - **Group for training, pilot project support and monitoring**
- Participants. Users involved in Academic Counselling: 316 ESPOL teaching staff who have counselling responsibilities and 8437 undergraduate students in all degrees and levels

Methodology and planning

The steps followed are the same as for the counselling tool. Table 4-39 shows the phases, activities, dates, methodologies, efforts, and artefacts for the execution of the pilot project

Phase	**Activity**	**Start date**	**End date**	**Methodology**
Preparation	Artefact development	March 2019	April 2019	Artefact development
Agreement	Agreement with the participants	April 2019	April 2019	(Same phase as for the counselling tool) Project meeting
Training	Training for users	April 2019	April 2019	(Same phase as for the counselling tool) Training workshop for users
	Training for administrators	April 2019	April 2019	(Same phase as for the counselling tool) Training workshop for administrators
Use	Monitoring of activities	April 2019 and 2020 September 2019 and 2020	May 2019 and 2020 September 2019 and 2020	Online activity analysis
Evaluation and Improvement	Evaluation	September 2019	September 2019	Filling out a survey
	General evaluation	18 April 23 April 2019 09 January 2020	18 April 23 April 2019 09 January 2020	Meeting with Vice Chancellor's Office, Student Welfare, Undergraduate Office, GSTI
	Documentation of improvements (in relation to training)	29 April 2019	29 April 2019	Documentation of improvements
	Analysis and documentation of improvements (in relation to use)	21 May 2019	3 September 2019	Documentation of improvements

Table 4-21. Prediction tool pilot planning

Phase 1: Preparation

In the case of the dropout prediction tool, this report is shared with the counselling tool and can be found under Phase 1: Pilot Baseline Report detailed in the previous section.

Phase 2: Agreements

The visualization of the dropout prediction tool is integrated into the counselling dashboards so the agreement report is the same as the other tools and can be found under Phase 2: Pilot Agreement Report detailed in the counselling tool section.

Phase 3: Training

The training for the prediction tool took place at the same time as the counselling tool and the process followed can be seen in the section Phase 3: Counselling Tool Training Report.

Phase 4: Use and Impact

Descriptive statistics of use records

According to the information obtained in the logs during the pilots carried out on the dropout prediction tool in October 2020, the following information has been obtained (table 4-40):

Type of use	Number of Lecturers	Number of Students	Semesters
Counselling in general	299	2393	2nd semester 2019
Having the dropout prediction panel enabled	213	678	2nd semester 2019
Accessing to see more information about the prediction	10	17	2nd semester 2019
Counselling in general	297	3822	1st semester 2020
Accessing to see more information about the prediction	26	56	1st semester 2020
Counselling in general	292	2906	2nd semester 2020
Accessing to see more information about the prediction	12	13	2nd semester 2020

Table 4-22. Number of actions in the tool

As can be seen in the table, out of a total of 2393 students only 17 received counselling based on the results of predicted dropout. These results are largely due to the positioning of the dropout prediction panel. This panel is located under the Statistics tab which was used by only 26 lecturers and which contains many panels. In the short time available to the counsellors, 15 minutes, it was practically impossible for them to review all the functionalities of the dashboard and therefore we decided to move the dropout prediction panel to the main screen of the advisory tool for the 2020 pilots.

Furthermore, the table shows that even when this prediction module was moved to the main window of the system, where all counsellors have access, the accesses increased slightly (from 10 to 12 for counsellors) who access to see more information about the system. Once again, it can be inferred that the little use is because counsellors have only 15 minutes for the counselling session with the student. It is difficult to access all the information that the system has in that limited time.

Phase 5: Evaluation and Improvement

In the first version to be piloted, in the second semester of 2019, the visualization shown in Figure 4- 4 was used. Due to inconsistencies in the dropout probabilities, on the fourth day of counselling it was decided to hide the dropout probability panel and proceed with an improvement in the prediction algorithms.

Once the predictive models were improved, a more conservative visualization was displayed, showing the panel if the student had a dropout probability higher than 50%. In this case, a button was enabled that when clicked displayed a panel showing brief explanations about the variables that most influenced the results.

Work is currently being done on the final version of the dropout probability visualization. This visualization will be shown on the main screen of the counselling tool from the first half of 2020 onwards, where the risk of dropout will be shown on a colour scale and not as a percentage, as counsellors were alarmed by a high probability of dropout. This groups the students by colour and does not show such exact information about the student's status. In addition, the most influential variables in the prediction will be shown and clicking on each one of them will display an explanation about it.

Surveys, and use logs, allowed for a more extensive analysis of the tool and the usefulness and impact it has had on the institution. In addition, this analysis will serve to further improve the visualization, explanations, and prediction models.

4.3.5 Summary of Pilotings in Universities External to the Consortium

4.3.5.1 Pilot of NoteMyProgress counseling tool at Universidad de Chile (UChile)

The NMP pilot at the University of Chile was done by adapting the NMP beta tool described in section 4.2.1 of this document. This pilot followed the same phases and strategies as the first pilot in PUC-Chile (described in section 4.2.1). However, since the tool was adapted for use in another institution, the main changes that took place in this pilot are highlighted below.

Resources

The resources related to the deployment of the tool were the same as described in section 4.2.1. of this document. However, in this case, two main agents from the Center for Teaching and Learning of the School of Economics and Business of the University of Chile were involved. Specifically, the center's director and the systems manager collaborated, coordinating with each other and two teachers.

- **Web server**. A web server is available to host the NoteMyProgress web application.
- **Google store account**. A developer type user is available to host and distribute the NoteMyProgress plugin to users (students).
- **Pilot team**. There is a team in charge of piloting the tool.
    1. ***Coordinator of the pilot project***, in this case, the director of the Center for Teaching and Learning of the School of Economics and Business of the University of Chile.
    2. ***Technicians in technological infrastructure***, in this case, one of the researchers/developers at the Pontificia Universidad Católica de Chile and the systems manager of the Teaching and Learning Center of the School of Economics and Business of the Universidad de Chile.

3. ***Training, support and monitoring group***. This team oversees preparing and disseminating the material for the training and support of the students during the period of the pilot, preparing the NMP tool with the necessary information about the courses in which the pilot takes place, inviting the students to participate in the pilot, sending evaluation surveys, following up the pilot, making adjustments during the pilot, documenting the process, extracting data for analysis. In this case, the role was played by a researcher/developer from the Pontificia Universidad Católica de Chile.

Methodology and planning

Unlike the previous pilot, this pilot was carried out over 4 months. The preparation phase, the agreement of the participants and the training took place in the first month, following the same methodologies established in the previous pilot. It was carried out during the start and end dates of the courses (see section 4.1.3) and the evaluation and improvement were carried out in relation to the events reported during the pilot, in order to understand the problems derived from the adoption of the tool by a third university. The different phases are described below.

Phase 1: Preparation

Intervened Process in the Pilot

In this case, four courses were defined by the Director of the Teaching and Learning Center of the School of Economics and Business of the University of Chile. The Table 4-23. Courses involved in the pilot with the University of Chile. For each course, the start and end dates of the pilot, the duration in weeks, the number of students registered in each course and the number of students who downloaded the NMP tool and used it throughout the course are indicated.shows the courses, with the start and end dates of the pilot, as well as their weeks of duration, the number of students and the number of students who used the NMP tool.

Name of the course	Dates	Duration in weeks	Registered Students	NMP students
The challenge of innovation in higher education	9/2/2019 -14/10/2019	5	284	41
How does technology change us?	8/26/2019 -02/12/2019	13	186	6
How to cope with the first work experience	09/09/2019- 11/11/2019	8	144	4
General Marketing	8/26/2019 -23/09/2019	3	638	44
		Total	1252	95

Table 4-23. Courses involved in the pilot with the University of Chile. For each course, the start and end dates of the pilot, the duration in weeks, the number of students registered in each course and the number of students who downloaded the NMP tool and used it throughout the course are indicated.

Current situation of the processes to be intervened

In this case and given that the objective of the pilot was to test the adaptation of the tool for use in a third institution, the installation and adaptation of the tool, which had not existed at the institution until now, was established as a baseline.

Phase 2: Agreements

Description of the pilot population

In this case, the intervened population is divided into two groups: (1) the actors involved in the installation and adaptation of the tool (the director of the Teaching and Learning Center of the School of Economics and Business of the University of Chile, and the systems manager of the center), and (2) the participants in the courses in which the tool was used (a total of 1,252 students were contacted, of which 95 downloaded and used the NMP tool).

Phase 3: Training

For this pilot, the systems manager of the Teaching and Learning Center of the School of Economics and Business of the University of Chile was trained. To this end, two meetings were held where the tool was demonstrated, with instructions on how to adapt it to the institution's courses, as well as a meeting to launch the pilot. The PUC contact group then exchanged several emails to check that the tool deployment was correct.

Phase 4: Use and Impact

For this pilot, unlike the one described in section 4.2.1, only the impact of the tool on the course students was analyzed in relation to the use of NMP, and the focus in this case was on the process of adapting the tool. For this purpose, the exchanges produced in the meetings between the PUC team and the systems manager of the Teaching and Learning Center of the School of Economics and Business of the University of Chile were analyzed in order to understand: (1) the difficulties in adapting the tool within the institution, and (2) the difficulties associated with deploying it in courses.

Phase 5: Evaluation and improvement

Main results

95 of the 1,252 registered students installed the tool. Among those who downloaded it, an analysis of the most used functionalities was made (**Error! Reference source not found.**). Of these, the most widely used functionalities were displays of interaction with the various activities (37%) and graphs related to time use (33.8%).

Figure 4- 18. Percentage of use of the different NMP functionalities among the 95 students who downloaded it.

Based on the analysis of the actions carried out for the adoption and deployment of the NMP tool at the Teaching and Learning Center of the School of Economics and Business of the University of Chile, the following conclusions are drawn:

1. The process of installation and configuration of the NMP tool for the adaptation of the different courses requires coordination between the two institutions, to ensure that the tool is used correctly.
2. A system manager is required at the university where the tool is applied to ensure its proper functioning and to send messages to students to inform them of its use.
3. The final coordination of the project requires the involvement of systems managers and researchers if similar conclusions to those of the first pilot are to be drawn. In that case, it is proposed that the methodology of analysis explained in chapter 4.2 of this document be followed.

Proposals for improvement

From the pilot carried out, some improvements to be incorporated in different versions of the tool were identified:

1. **Offer an automatic system for the adaptation of the tool to the different courses**. In this case, the adaptation of the tool to the different courses was carried out with the support of one of the researchers/developers of the PUC. However, this process could be automated by creating a type of system indicating the characteristics of the course to be uploaded and loading its contents automatically. In the case of working with a Learning Management System such as Coursera, this process can be complicated, as there is no access to the course database. However, in other systems such as Moodle, this problem would be solved.

Provide support to course managers in sending messages. The sending of messages to inform students about the tool and its potential is done from messages in Coursera sent by the course manager or their teachers. This process could also have been automated from the start to leave information messages for students. Currently Coursera integrates a system to plan the message sending, so this could be solved from the beginning of the pilot. However, at the time this pilot was developed, this option did not exist.

4.3.5.2 Pilot project of counseling and prediction tool at Universidad Politécnica Salesiana (UPS)

The SCA grade counseling and forecasting tool supports the teacher in having personalized conversations with students. The tool aims to improve the academic counseling process through visualizations based on academic, personal, and scholarship data, among others.

The tool was developed using NodeJS technologies with an implementation of two layers of abstraction: the model and the controller, along with configuration files for database connection and information needed for connection to the authorization server. However, the implementation of an API implies that a security and authentication protocol is in place to prevent unauthorized applications or users from accessing the data. For this purpose, the OAuth 2.0 protocol was chosen, which defines the flow of authorization protocols according to the implementation design of the application, thus allowing access to data in a secure manner. For the consumption and loading of data from the main application, the creation of a REST API was chosen.

Resources

The resources used for the execution of the pilot project were as follows:

- Server to host the tool
- Computer technician for service support (tool availability)
- Project researchers for data collection and analysis
- Pilot Team
  - Academic Vice-Rectorate Team
  - Guayaquil Vice-Rectorate Team
  - Psychology Degree Program
  - Student Welfare
  - Technicians in infrastructure and technological support
  - Group of training, support for the pilot project and tracking
- Participants. The target audiences to be reached within the university are:
  End users: UPS professors who voluntarily decided to support the pilot of this project and undergraduate students from all degree programs and levels.

Planning

Table 4-42 presents the phases, activities, dates, methodologies, efforts, and artifacts for the execution of the pilot project. It should be noted that because SCA integrates the advisory and forecasting dashboard, planning includes both pilots.

Phase	Activity	Start date	Termination date	Methodology
Preparation	Development of the tool	October 2019	December 2019	Artifact development
Agreement	Agreement with the participants		April 2020	Project meeting
Training	Training for users	May 2020	May 2020	User training workshop
Use	Monitoring of Activities	May 2020	September 2020	Online activity analysis
Evaluation and Improvement	Evaluation	May 2020	May 2020	Filling out a Likert survey
	General evaluation	September 2020	September 2020	Meeting with Rectors and Vice-Rectors.
	Documentation of improvements (In relation to training)	September 2020	September 2020	Documentation of improvements

Table 4-24. Planning of SCA counseling pilots

The development and results obtained after the execution of each of the activities of the phases mentioned in Table 4-42 are described below.

Phase 1: Preparation

The UPS did not have an academic counseling process, so the pilot conducted at the Guayaquil headquarters during the pandemic was the start of learning from the experiences in the use of the tool, as well as to receive the suggestions presented by the teachers during the academic counseling pilot in which they promoted tutoring programs in the subjects that have academic performance problems.

Phase 2: Agreements

Within the agreements at the Guayaquil headquarters, 17 undergraduate degree programs joined the project with 119 teachers, distributed as presented in table 4-43.

Degree Program	Number of Teachers
Business administration	59
Accounting and auditing	41
Industrial engineering	38
Computing and system engineering	36
Electronic engineering	36
Electrical engineering	32
Automotive engineering	17
Mechatronic engineering	9
Communication and social communication	8
Psychology	7
Telecommunications	7
Biotechnology	5
Early education	4
Environmental engineering	4
Civil engineering	4
Basic schooling	3
Economics	2
Total	**119**

Table 4-*25*. Distribution of Professors by Degree Program

Phase 3: Training

Description of the Training Phase

Sixteen one-hour training workshops were held. They were carried out in the month of May 2020. The goal of the workshops was to provide instruction that would allow UPS teachers to understand how the SCA tool supports dialogue between teachers and students.

The following activities were carried out during the training:

Activity 1

- Presentation of the Academic Counseling Tool "SCA" "Table 4-2", referring to the LALA project.

Activity 2

- The professors completed a usability survey.

Training Phase Participant Satisfaction

39 professors out of 119 completed the Likert scale questions between 1 (completely disagree) and 10 (completely agree) on usability with the current counseling tool. The answer was qualitatively sound.

It can be seen from the professor survey that a higher percentage of professors estimate that they will use the tool often as well as that the tool has a user-friendly and intuitive interface.

Below are some graphs with the details of the survey results:

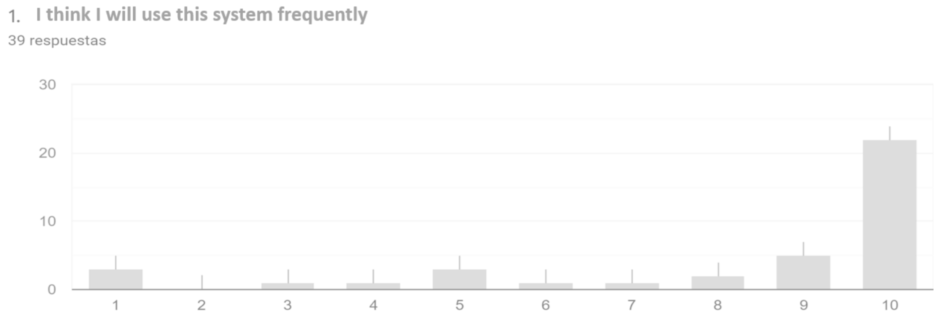

Figure 4- 19. Usability Survey

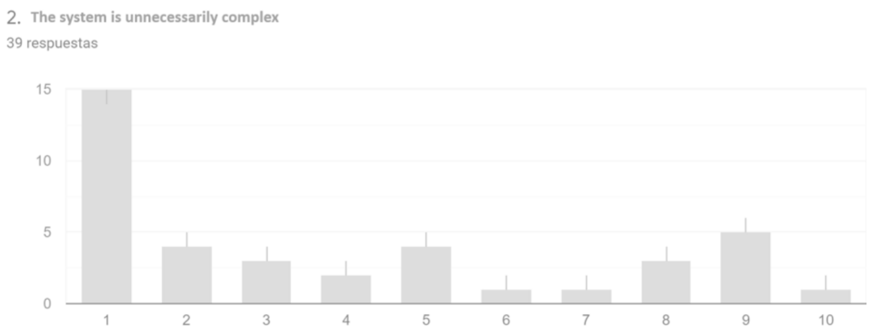

Figure 4- 20. Usability Survey

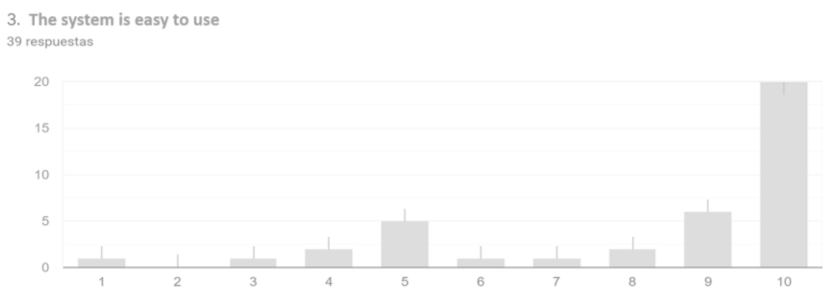

Figure 4- 21. Usability Survey

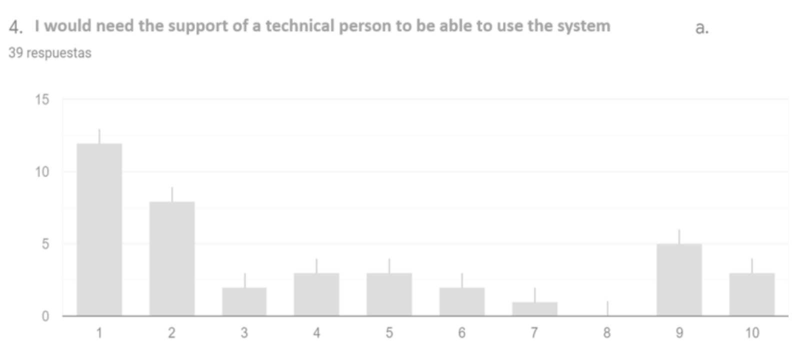

Figure 4- 22. Usability Survey

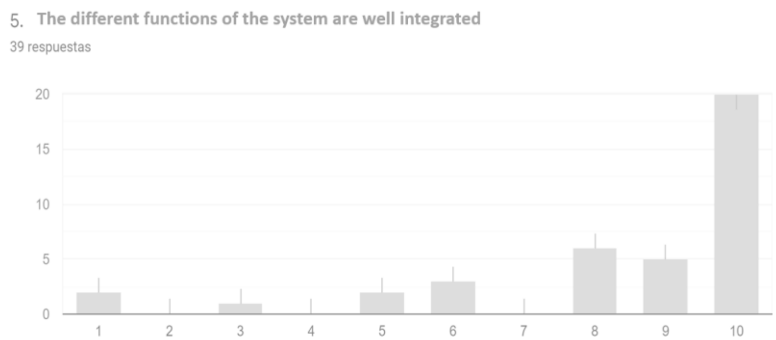

Figure 4- 23. Usability Survey

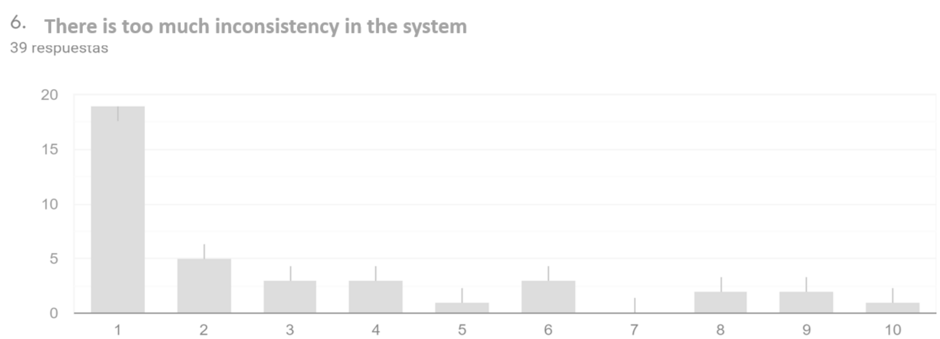

Figure 4- 24. Usability Survey

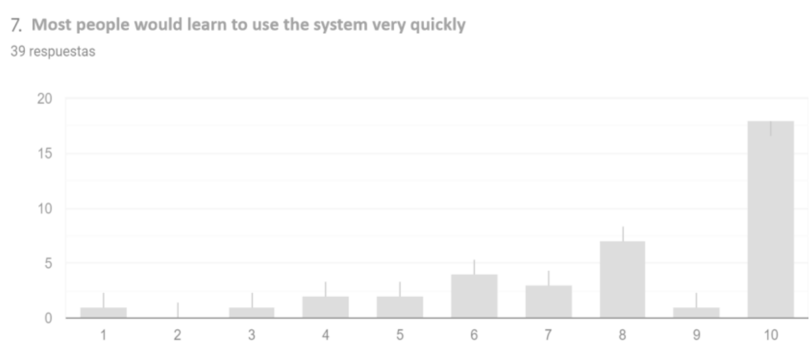

Figure 4- 25. Usability Survey

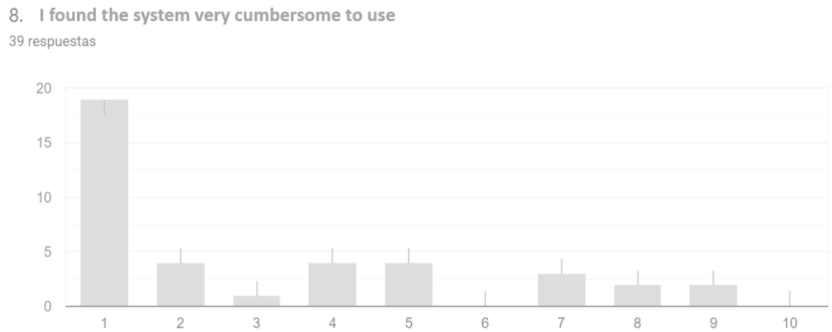

Figure 4- 26. Usability Survey

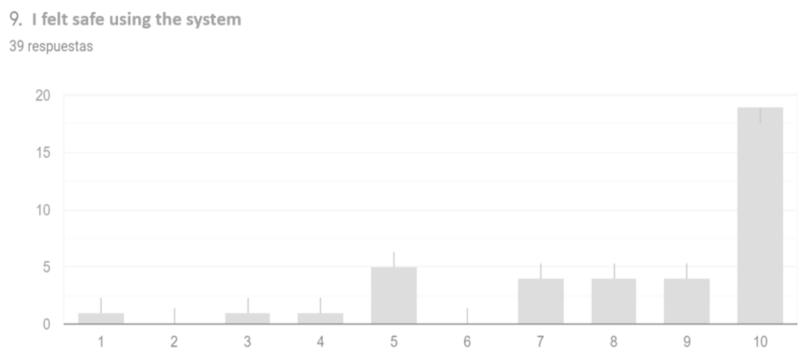

Figure 4- 70. Usability Survey

Figure 4- 27. Usability Survey

Phase 4: Use and Impact

Descriptive statistics of usage records

The SCA tool has a log record that stores the actions performed by users in it. Statistics show that users have been actively involved, this is reflected in 119 tutors who have consulted the tool, the system records observations of 3668 students and also shows that a total of 4652 students were searched. Table 4-44 shows the number of observations recorded per degree program.

Students who received academic counselling	
Degree program	**Total**
Business administration	863
Accounting and auditing	661
Industrial engineering	572
Electricity	359
Psychology	326
Computer science	201
Communication	178
Electronics and automation	157
Automotive engineering	92
Environmental engineering	80
Civil engineering	74
Mecatronics	36
Early education	21
Basic schooling	16
Telecommunications	15
Economics	14
Biotechnology	2
Mechatronic engineering [unified]	1
General total	**3668**

Table 4-26 Total Students Approached.

Table 4-45 shows the results of the logs obtained from the LALA project

Action	Count
Search for student.	4,652
Open comment popup	3,689
Add observation	3,668
Open student information popup.	511
Open dropout popup.	87

Table 4-27. Log Register

Phase 5: Evaluation and Improvement

The following results were obtained through surveys of students at the end of the academic year (table 4-46).

Which of the following ways were you contacted about your personal situation?	
Zoom	38.28%
Call to cell phone	25.83%
WhatsApp Message	19.64%
WhatsApp Call	7.57%
Institutional mail	5.22%
Conventional phone call	3.47%

Table 4-28. Means of contact to offer counseling.

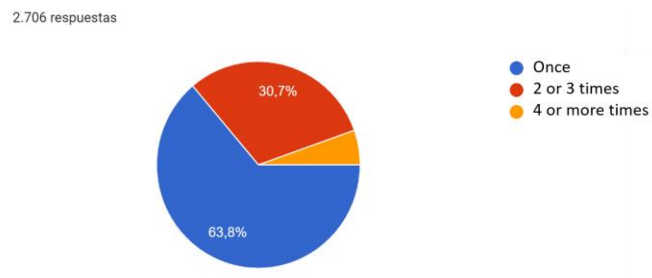

Figure 4- 28. How many times did university contact you to know about your personal situation?

What topics were covered in the conversation with the teacher who contacted you?	
Academics	2363
Entrepreneurship	19
Spiritual	16
Family	1
Financial	237
Psychological	19
Health	2

Table 4-29. What topics were covered during the academic counseling session?

4.3.5.3 OnTask pilot at Universidad Federal Rural de Pernambuco (UFRPE)

OnTask is a tool with functionalities to enable the interaction between students and instructors through the provision of personalized feedback. The feedback generated using OnTask is reusable and potentially reduces the overload of the instructors. The main objective of the tool IS to improve the academic experience of students through the delivery of timely, personalized and actionable student feedback throughout their participation in a course.

Resources

The resources used for the execution of the pilot project were as follows:

- Server to host the tool.
- Computer technician for service support (tool availability).
- Project researchers for data collection and analysis.
- Pilot Team
    - **Project Coordinator**
    - **Specialists in technological infrastructure**
    - **Group for training, pilot project support and monitoring**
- Participants. The target audiences to be reached within the university are:
  End users: instructors of Computing department.
  Students: undergraduate student from computer science program.

Planning

Table 4-48 presents the phases, activities, dates, methodologies, efforts, and artefacts planned for the execution of the pilot project. During the execution of the project, these phases were adapted to various emerging situations, such as the rescheduling of academic activities.

Phase	Activity	Start date	Termination date	Methodology
Preparation	Artefact development		08/2019	Development of agreement and survey.
	Tool Setup		08/2019	Instantiation of a server with OnTask with access for the instructors of UFRPE
Agreement	Agreement with the participants		08/2019	Project meeting
Training	Training for users		09/2019	Training session to present the tool and relevant concepts about how to provide feedback.
Use	Accompanying users	08/2019	12/2019	Face-to-face support
Evaluation and Improvement	General evaluation		12/2019	Evaluation by survey
	Staff evaluation		12/2019	Informal interviews with instructors

Table 4-30. OnTask counselling pilot planning

A description follows of the development and results obtained after carrying out each of the activities in the phases mentioned in Table 4-48.

Phase 1: Preparation

Processes included in the pilot project

UFRPE has low completion rates of undergraduate programmes. Students at UFRPE have frequently complained to the course coordinators about the lack of interactions with the instructor outside the classes. Although it is recognised that feedback plays a crucial role in learning success and the overall learning experience, the teaching staff are generally overwhelmed with teaching and administrative activities, which are time consuming and demanding.

To tackle this issue, we held conversation with academics, to try to identify the points in the course and the type of messages they would like to convey, and then how to personalise them to the students. We detect elements in the course design that would provide the evidence used to that personalisation, and, finally, we identify the data sources you need for that personalisation.

Current indicators for intervention processes

At UFRPE, it is not a common practice to provide written feedback in face-to-face courses. In general, students receive oral feedback in-class. As indicated earlier, students have made complaints about the lack of written feedback. In addition, there is no formal instrument to measure student satisfaction with the feedback process. Therefore, we introduced OnTask to address the issue considering the ability of the tool to provide personalised feedback to large cohorts efficiently. We developed a survey which contains 17 items that measure the following aspects:

- How important students perceive feedback, and
- How well OnTask has performed in terms of providing effective feedback.

Among these items, thirteen of them also measure 'impact' and 'usefulness':

- Impact: impact on decision-making and self-regulated learning
- Usefulness: the tool meets the learning needs

For more details, please see Section 'Phase 4: Usage report' - Results from the observation instruments.

Current situation of processes included

Since this pilot project does not include comparative measurements between the results obtained during the pilot and previous years, it is not necessary to create a baseline. The evaluation of the usefulness and impact in general and specifically on student performance will be carried out based on the results obtained after the pilot. In particular, we assess the impact by measuring the effect on student decision-making and self-regulated learning and the usefulness by measuring how OnTask meets the learning needs.

Phase 2: Agreements

Description of the pilot population

A total of 3 instructors singed a letter as an agreement to participate in this pilot. In addition, 112 students agreed to participate by consent document. Table 4-49 shows detailed information of the pilot population.

Role	Unit	Amount of time performing the role	Age range	Gender	**Comments**
Instructors	Computing department (UFRPE)	6-8 years	30-38	Male: 67% Female: 33%	* The three instructors taught the following courses: 1) Text mining (Mineração de texto) (Student number: 52), 2) Introduction to virtual learning environments (Introdução à ambientes virtuais de aprendizagem) (Student number: 43), 3) Software Engineering (Engenharia de software) (Student number: 17)
Students	Computing department (UFRPE)	N/A	17-45	Male: 83% Female: 13% Other: 4%	The initial population of students.

Table 4-31. Description of the pilot population

Phase 3: Training

Description of the training phase

As the initial pilot was focused on three instructors, the training session was performed in one day. During this training session, we presented concepts of feedback and provide step-by-step tutorial on writing feedback using OnTask (Detailed tutorial created by the OnTask research team). Due to the number of people involved, the training session was more informal, without presentation and materials. The main goal was to provide a tutorial on how to use the OnTask tool. Moreover, we provided the material that we had used for the LALA project.

It is important to highlight that we focused on how to personalize emails using the tool, and tips on how to provide useful feedback.

Evaluation of satisfaction of training phase participants

OnTask is meant to assist instructors in the process of providing feedback, i.e., saving time. There was no plan to evaluate learning outcomes. In general, the OnTask functionalities used during the training were easily understandable by the participants and they were able to reproduce the activities without any problem. Questions were answered during the session. It is important to highlight that the participants have a background in computer science, and hence the operation of the tool was not difficult to learn. After the training session, the participants indicated that they were confident to use the tool in a real scenario.

Phase 4: Use and Impact

Descriptive statistics of use records

The instructors have used the tool to provide feedback on a weekly basis. According to the logs of the tools, the instructors who used OnTask usually prepare feedback messages three days before sending them to students. On average, the weekly emails required 3-4 sessions of preparation for instructors, and each session lasted for 30-40 minutes. However, once a personalised email applying rules of computational logic is completed, it only took 5 minutes on average for instructors to send it to the whole cohort. The instructors also used the dashboards (a statistical summary of different inputs of data about learners) provided by OnTask on a weekly basis when constructing feedback even though this functionality was not particularly highlighted during the training. On average, each instructor accessed the tool 10-15 times per week.

The tool was used on a weekly basis to send feedback to students. However, the tool was also used to create the rules and text for the feedback at least a couple of days before sending the email. In short, the feedback was usually sent on Friday, but the instructor would have to start using the tool on Wednesday each week. During the piloting period the participants had 2 meetings for technical assistance (e.g., how to apply rules to the email content).

Only two out of three instructors continued to use the tool throughout the semester. The instructor that didn't use the tool said that it was due to methodological reasons (i.e., course activities that were not directly compatible with OnTask – open questions), and not because of technical difficulties.

Phase 5: Evaluation and Improvement

Description of evaluation and improvement

After training and making the tool available for use, an assessment was made of whether participants perceive an improvement in the application resolution process. This improvement was measured by informal conversations with instructors to assess the overall satisfaction of the instructors. We also assess the student perception by a survey. The result of this evaluations was discussed below, and as will be seen below, they show a positive impact that meets the expectations for the tool and for the pilot project.

Results related to utility in instructors and students

Regarding Instructors using the tool, the usefulness, in general, was high, especially in saving time and providing feedback in a higher frequency/timely manner. For instance, one of them had a class session with 56 students, which is a large cohort of students in our context. This instructor indicated that the effectiveness of the feedback provided could be noticed by the increase in students' classroom interactions after the use of OnTask. Instructor B found the tool useful in freeing up time to focus more on constructing the content of effective feedback. Moreover, she/he stated that several students expressed their appreciation of the feedback received.

Regarding the students, overall, students were quite positive about the feedback received through OnTask, especially the 'feed-up' and 'feed-forward' elements (working towards desired goals and adjusting learning strategies). However, the students were comparatively less positive about the 'feed-back' element, which is being able to identify their strengths and weakness with the feedback. The results show areas where we can strengthen the training for teachers in terms of constructing effective feedback using OnTask.

Results related to impact, performance and usefulness in students

We sent out a survey to students at the end of the semester (December 2019) to measure the performance of OnTask. Students were asked to use 7-point Likert scale to rank how 'important' they perceive the important aspects of feedback and how well the feedback provided using OnTask has achieved each aspect. The survey is accessible here.

A total of 48 students answered the survey (response rate=42.8%)

- Importance: All the statements received average scores higher than 6 (baseline 6.08), showing high appreciation of all the important aspects of feedback.
- Performance: All the statements received average scores higher than 5 except for the statement, "The course feedback that I have received shows that my instructor understands my strengths and weakness" (M=4.85), showing that students were generally satisfied with the feedback received through OnTask.

The largest gap between student perception of 'importance' and the performance of OnTask is observed in the following statement: "It is important that course feedback identifies the learner's strengths and weakness".

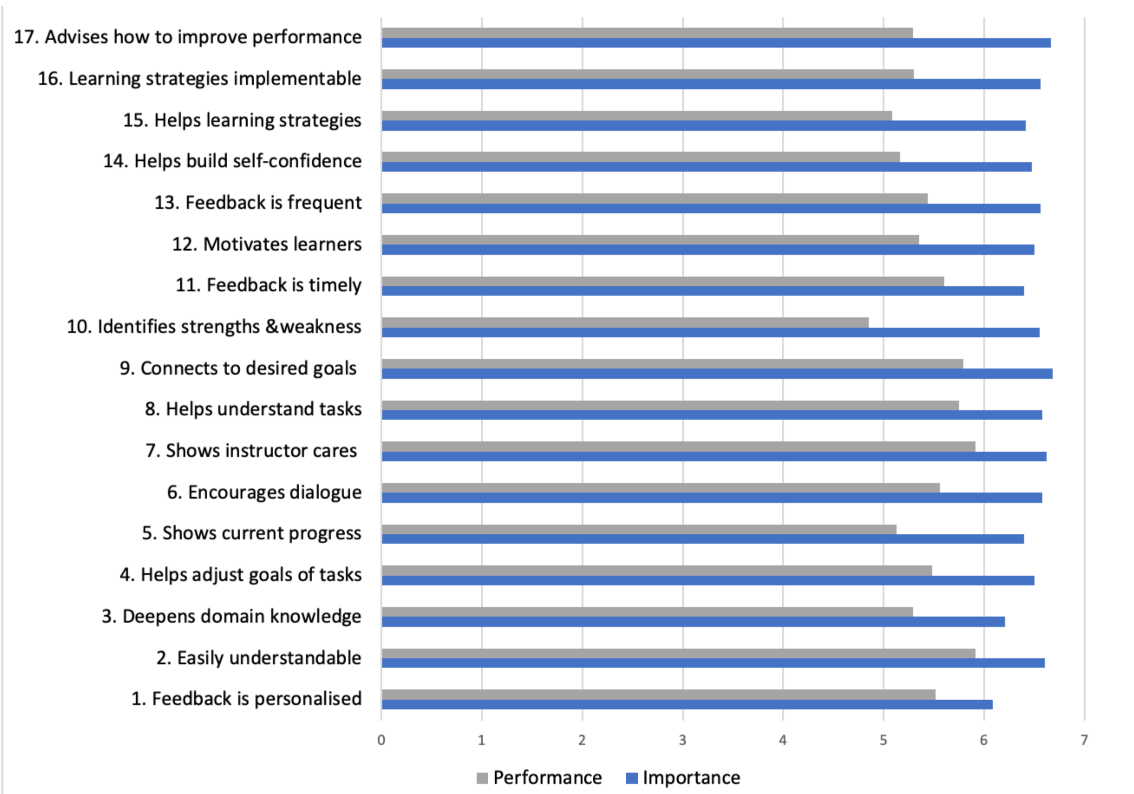

Figure 4- 29. Perceptions of feedback elements and OnTask performance

13 of the 17 'performance' statements can be used to evaluate the impact (Table 4-50) and usefulness (Table 4-51):

- **Impact** (I): The tools serve as an example for new ideas and implementations. Decision-making based on data, etc.
- **Usefulness** (Us): Counselling and guidance by teachers is more oriented to the needs of each student, based on their data and the data of previous students.

Impact: informs decision-making
The course feedback that I have received deepens my domain knowledge.
The course feedback that I have received helps me adjust my own goals of the course tasks.
The course feedback that I have received makes me feel that my instructor cares about me.
The course feedback that I have received helps me understand the course tasks better.
The course feedback that I have received motivates me to work towards a desired goal.
The course feedback that I have received helps build my self-confidence.
The course feedback that I have received helps me develop and adjust my learning strategies.

Table 4-32. Items that indicate the impact of OnTask

Usefulness: meeting the needs
The course feedback that I have received shows me my current progress.
The course feedback that I have received encourages dialogue between me and the instructor.
I can connect the course feedback that I have received with the desired goals (standards) of my course tasks.
The course feedback that I have received is timely.
The frequency of the course feedback is appropriate.
The course feedback that I have received gives advice on what I can do to achieve the desired performance.

Tabla 33. Items that indicate the usefulness of OnTask

The responses to these items are presented in the following two bar charts. Medians are denoted by the red solid red lines, boxes represent interquartile ranges (IQR), whiskers are 1.5 IQR, and data points are marked with grey dots. Answers to N/A are not counted).

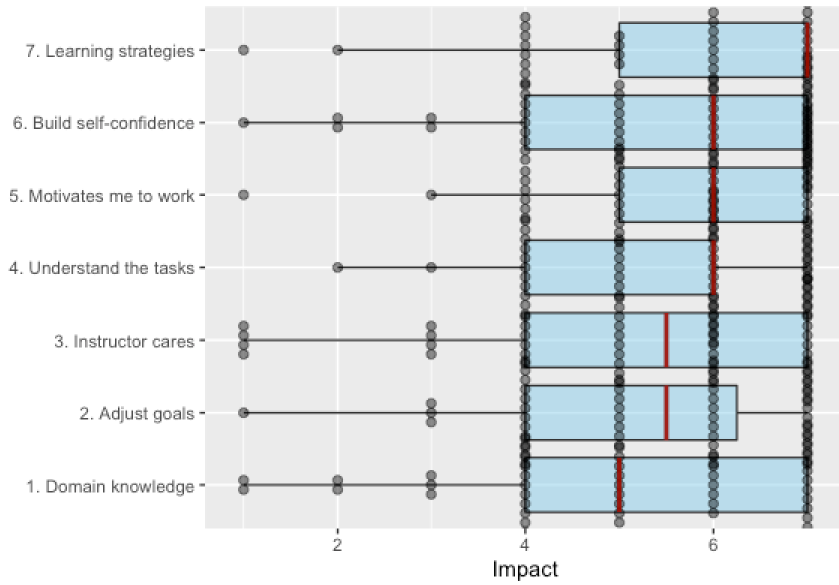

Figure 4- 74. Impact Results

The plot of **impact statements** shows that students tended to agree strongly with the following statements:

- The course feedback that I have received helps me develop and adjust my learning strategies.
- The course feedback that I have received motivates me to work towards a desired goal.

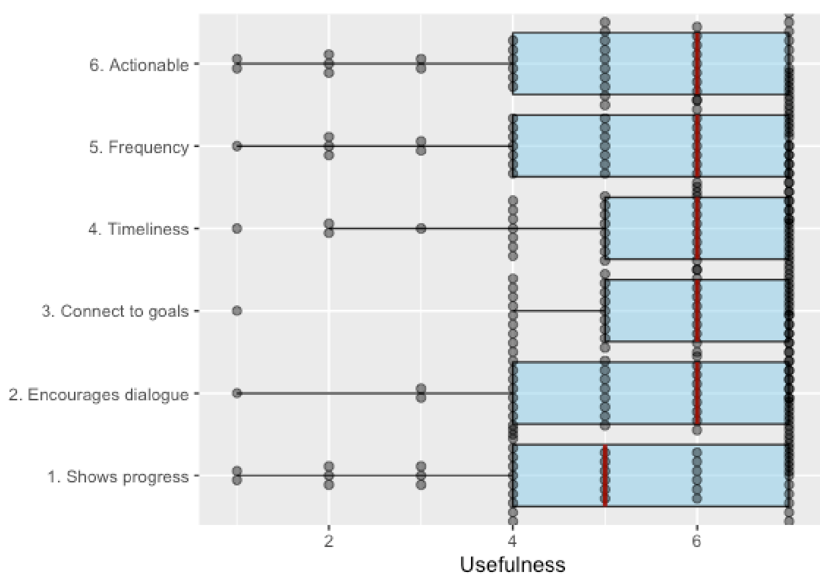

Figure 4- 30. Usefulness result

The plot of **usefulness** statements shows that students tended to agree strongly with the following statements:

- The course feedback that I have received is timely.
- I can connect the course feedback that I have received with the desired goals (standards) of my course tasks.

Summary of Improvement Proposals

We intend to recruit more teaching staff to use OnTask in the next semester. Besides, we were using an English version of the tool, but we intend to adapt it to Portuguese before the next semester.

Post-project analysis results

The pilot showed that we need to provide more workshops to highlight the importance of the feedback process in the learning process. As mentioned before, it is not usual for Brazilian teaching staff to provide written feedback in a face-to-face context. However, the experience during the pilot could motivate more people to get involved in the next round.

Moreover, the computing department of UFRPE is keen to encourage instructors to adopt tools that enhance students' experiences. To do so, this department will propose a series of workshops and tutorials about different tools; one of them is OnTask. We expect to reach a broader population of people with these workshops and to promote OnTask.

In the next pilot, we intend to carry out interviews to gain a deeper understanding of instructors' experience using OnTask to provide feedback and students' experience receiving feedback through OnTask. Finally, we will personalize the OnTask interface using Portuguese, and possibly to reduce the number of features available, to make the tool easier to understand.

Lessons learned:

Regarding the process of piloting OnTask is important to first engaging with end-users by identifying what are the points in their course where they would clearly benefit from "talking" to the students to head conversation with end users, try to identify the points in the course and the type of messages they would like to convey, and then how to personalise them to the students. Detect elements in the course design that would provide the evidence used to that personalisation. Finally, we identify the data sources you need for that personalisation. If the data sources don't exist, the next stage in the conversation is to consider potential adjustments to the course design to set up this data.

Regarding evaluation: If you have student surveys at the end of the course, see if you have a question that asks explicitly about feedback. Compare the results with those from previous years.

If you don't have any question about feedback but you can insert just one question in this survey, see if you could include something like "the feedback given to me during the course helped me to learn". You may also consider organising focus groups at the end of the course with the students.

4.3.5.4 Pilots with the prediction tool at Instituto Tecnológico de Zitácuaro

The dropout prediction tool designed at Instituto Tecnológico de Zitácuaro is a tool to detect students at risk in different degrees of the university. The objective of this tool is that it can provide the probability of completing the degree of each student (in a range from 0 to 1, with a value of 1 for those who complete the degree). For the implementation of this tool, other tools for academic prediction implemented within the LALA project were taken as a base, and an adaptation of these tools to the contexts and needs of Instituto Tecnológico de Zitácuaro was made. The code of the tool was implemented in Python 3.8, using the Anaconda distribution. This distribution was used to facilitate the use of data analysis and machine learning libraries in the implementation. The current version of the tool is designed to work in command line.

For the development of the code, the first elements to consider are the data from the institution. In this case, four files were used for the adaptation. These files can be directly obtained from the academic database. These files contain the following information:

- Students. It contains the general data about the students, including the degree they study, the first enrollment year, current data about their progress and demographic information.
- Progress: It includes the results of each student in each of the courses for each semester.
- Degrees: It includes details about the degrees, including the academic plan and the total number of credits, which can be combined with the previous information.
- Courses: It is a catalog with detailed information about the courses that are taught in the different degrees.

In these files, the information used for the adaptation is as presented in the following table:

Variable	**Description**
	Students file
numero de control	Student identifier
periodo de ingreso	Indicates the period when the student was first enrolled in the degree. For example, 20161 means that the student first enrolled in the first semester of 2016
identificador de carrera	Identifier of the degree students are doing
semestre actual	Indicator of the number of semesters students have taken
estado	Indicator of whether or not the student is active. Students may not be active if they have finished their degree or they are on leave or on furlough
creditos aprobados	Indicator of the number of credits students have passed
	Progress file
numero de control	Student identifier
materia	Identifier of the course the student has taken
calificación	Grade of the students in the course. Grade is expressed in a range from 0 to 100, with a passing rate of 70
creditos	Indicator of the number of credits that can be achieved with the course
tipo de curso	Categorical value that indicates the number of attempts the student has done for each course. In Instituto Tecnológico de Zitácuaro, a course can be taken 3 years at most, and a course can be attempted twice each year at most. This way, this variable can take the following variables: - Evaluación Ordinaria Primera Vez (Ordinary Evaluation First Time, 1st attempt in the first year) - Evaluación Ordinaria Segunda Vez (Ordinary Evaluation Second Time, 2nd attempt in the first year) - Evaluación Regularización Primera Vez (Regularization Evaluation First Time, 1st attempt in the second year) - Evaluación Regularización Segunda Vez (Regularization Evaluation Second Time, 2nd attempt in the second year) - Especial Cursado (Special Taken, 3rd year) Moreover, there are some special values such as Evaluación Extraordinaria Primera Vez (Extraordinary Evaluation First Time), Convalidación (Convalidation) or Equivalencia

	(Equivalency) to reflect courses that are incorporated into the student record from other degrees and/or institutions.
periodo	Indicator of the period when the course is taken. It has 5 digits: the first four indicates the year and the last one indicates the semester, which can be 1, 2 or 3. For example, in 2020, possible values are 20201, 20202 and 20203. The first period is taken from February to June, the second period is taken from July to September and it is used to regularize some courses the students have pending, and the third period is taken from September to December
Degrees file	
carrera	Identifier of the degree
total de creditos	Indicator of the total number of credits the degree has. Generally, Bachelors' degrees have a value of 260 (260 credits) and Masters' degree have a value of 100 (100 credits)
Fichero materias	
identificador de materia	Identifier of a course that students can take
clave de la materia	Internal notation/identifier of the course, according to the educational program
nombre completo de la materia	Detailed name of the course
creditos de la materia	Number of credits the course has
carrera	Identifier of the degree the course belongs to
reticula	Indicator to identify the temporal validity of the course for a specific academic plan

Considering the presented information, the tool carries out several filters to retrieve students' information after their first semester, after their first two semesters, and so forth until their first five semesters. This way, this filtered information can be used to better train the models. For example, if the model has to predict dropout for a student who has only taken one semester, that prediction should be done based on a model trained with data of a single semester. Additionally, there is a set of data which includes all students' information from the beginning.

From the aforementioned data, variables are computed to be used in the models. These variables include the rate of passed and failed courses, the average grade of the courses (i.e., GPA), considering only passed courses, and considering both passed/failed courses. Moreover, there are some variables related to the number of courses the students are repeating, as they can indicate some risk of dropout. Furthermore, it is necessary to determine whether or not a student has dropped out the degree in order to train the model. In order to do that, the following rules are considered:

- If a student is not enrolled in any course for one year, it is considered as dropout. For example, if a student enrolled for the last time in 2019, but he did not enroll in 2020, it is automatically flagged as dropout (0).
- A student is considered as a completer (not dropout) when s/he completes 90% of the credits at least. This is done to increase the training data, as there are many students in the last stage of their degree. This assumption is reasonable as most of the students who complete 90% of the credits finish their degree.

With these data, the algorithm firstly detects who are the students that are currently studying the degree (to assign them a value of 2 in the dropout variable). These students do not have neither the dropout condition (0) nor the completion condition (1). For example, a student who have enrolled in the last possible semester (but s/he has not finished the degree yet) would be a student currently taking the degree (with value of 2). These students are removed for the training phase of the algorithm as their label

(0 or 1) is unknown. The rest of the students are used to train the models, which are developed using *ensembling* techniques. After the models are developed, predictions are carried out for those students whose label is unknown. Finally, a file is generated. This file contains the predictions for all the students (identified with a control number). Therefore, for each student, there is a value between 0 and 1 with the probability of finishing the degree. For students who have already finished or have already dropped out, a 0 or 1 is indicated in a separated column, but their predictions are empty as their status is known beforehand (no predictions are needed).

Moreover, in order to help instructors, some variables are also presented. The aim is that these variables help to understand students' situations. These variables are the variables that are calculated to be used in the model, and they have been presented earlier. As a complement for these variables, the number of semesters the student has taken is also given so that this information can give an idea about if the good/poor achievement is at the beginning of the degree or there is some continuity over time. This fact may also affect dropout as students who have taken several semesters may be less likely to drop out.

Considering the aforementioned system and the predictions, the tool aims to support program directors to identify students who have a higher probability of dropout. This information can be used to take specific corrective measures. For example, one variable considered in Instituto Tecnológico de Zitácuaro is the maximum number of credits a student can take each semester. If a student has a high probability of dropout, this maximum number could be decreased to avoid that the student takes many courses and fail them. Moreover, counsellors could improve their tutoring sessions based on the information of the tool, so that they could improve the efficiency of these sessions so as to reduce dropout rates.

Resources

This section describes the resources of the project to carry out the pilot of the dropout prediction tool.

6. **IT equipment**. Several laptops (those used by the researchers) with the Anaconda distribution (for Python) are used to execute the tool.
7. **Research team**. There is a team of 4 people in charge of collecting and analyzing the data collected during the pilot period.
8. **Pilot team**. There is a team in charge of piloting the tool.
    a. ***Project Coordinator*.**
    b. ***Specialists in technological infrastructure***.
    c. ***Group for training, pilot project support and monitoring***.
    d. ***End users*.** The end users will be the program directors of the 10 degrees (5 people) that are piloted. Nevertheless, the pilot is actually carried out with 6 professors that teach in these 10 degrees.

Phase 1: Preparation

Processes included in the pilot project

The purpose of this pilot is to carry out an evaluation of the tool with students of 10 degrees of Instituto Tecnológico de Zitácuaro. These degrees involve: Bachelor's Degree in Administration, Public Accountant, Business Management Engineering, Computer Systems Engineering, Industrial Engineering, Food Industry Engineering, Sustainable Agricultural Innovation Engineering, Architecture and Civil Engineering.

All degrees have a duration of 10 semesters (5 years), although students may take more or less time depending on their performance in the courses, considering that they can only take the same course for 3 academic years.

During this pilot, the aim is to obtain dropout predictions for those students who have enrolled from 2014 onwards at Instituto Tecnológico de Zitácuaro. From these predictions, the aim is to validate the accuracy of the tool and to obtain some feedback from the stakeholders on its usefulness. This way, this pilot will serve to improve the tool in the future so as to make the tool as useful as possible for the counsellors.

Current situation of processed included

The objective of the pilot is to obtain feedback of the tool to maximize its efficiency and efficacy for its use by program directors. Currently, there is an institutional tutoring program. In that program, students receive technical counselling during the first half of their degree at least. This way, program directors can better guide their students. In order to improve the tutoring program, this tool aims to provide further and better information to the directors about dropout and related indicators. This way, the monitoring process can be improved. In this line, this pilot aims to validate the tool by the stakeholders.

Phase 2: Agreements

Description of the pilot population

The pilot used data from Instituto Tecnológico de Zitácuaro from 2014. Particularly, data from 10 degrees were used. These data included registers from 2,128 students in the aforementioned period. These students represent the analysis group for this pilot.

Moreover, eight professors participated in the pilot. These professors were selected so that there was at least one professor who taught in each of the 10 degrees involved in the pilot. This way, professors knew the context and the profile of the students in each degree, and they could provide valuable and appropriate information about whether or not students were likely to drop out.

Phase 3: Training

For this pilot, training was conducted for the participating professors, and they were explained the tasks they had to do throughout the pilot. In particular, professors were provided with the data containing the results of predictions, together with a column in which they were asked whether or not they believed students were going to drop out the degree. Professors had to fill that column with a 0 (dropout) or 1 (completion) for each of the students based on their experience, their knowledge about the students, or the information of the indicators that appeared with the predictions.

Phase 4: Use and Impact

For the evaluation of the pilot, eight professors were asked to indicate whether they believed students were going to drop out the degree or not. This process was done with about 7.5% of the students. Because of that, in this pilot, the tool was used on a subsample of 159 students. These students were classified in two groups to analyze different groups of students:

- Group 1: It included random students of the sample. This group was used to validate the overall performance of the tool. There were 89 students in this group.
- Group 2: It included students with a status different than ACT (active). This means that it included students who had actually dropout, they were on a furlough, etc. The objective was to verify how the performance was for these special cases. There were 70 students in this group.

For the evaluation of the pilot, results obtained with the tool were compared with those obtained in the pilot (by the professors involved). Results showed a precision of 72% for those students that were randomly selected (group 1, with 89 students). Moreover, the tool showed a precision of 71% for those students with status different than ACT, active (group 2, with 70 students). Finally, when both groups were considered together, the tool showed a precision of 72%. This means that the tool can provide predictions with a moderate performance. Nevertheless, it is possible to refine the model to improve it, and there is a plan to do it in the next months.

The main comments received by the professors in relation to how the tool works are as follows:

- In the table of results, there are some students who are taking their professional internship. This course is carried out in the last stage of the degree and most of the students pass it and complete the degree without issues. This fact should be included in the next versions of the model.
- It is desirable to include more irregular students, as they will be useful to improve dropout predictions.

In summary, this pilot has served to validate the overall performance of the dropout tool developed at Instituto Tecnológico de Zitácuaro. Currently, the tool is potentially available to provide predictions of more than 2,000 students and it has been tested with 159 students. The tool has a moderate precision, and the pilot has served to identify some points for improvement. These improvements are planned to be done in the coming months, as this tool is considered very relevant in this context, considering the existing problems with dropout, recently accentuated with the pandemic.

4.4 Summary of Results

The execution of the pilots detailed in this document provides evidence that the incorporation of LA tools in the considered institutions of Latin American, when aligned with institutional needs and focused on impact in decision making, has positive effects. These effects are evident in terms of institutional capacity building, support for improved student performance and user satisfaction. Perhaps most importantly, their incorporation has established a starting point for encouraging LA adoption at participating universities.

In summary, ESPOL implemented new learning analytics in an existing tool used in the academic counselling process already in place throughout the university. Counsellors positively evaluate the new features to support decision-making during student counselling sessions. In the case of UACh, a new tool was implemented, separate from the existing academic information system, to be used by counsellors (school directors) to support the decision on a special request for enrolment or dropout. Counsellors indicated that TrAC makes their work easier, saves time and allows them to better support their decisions. UCuenca implemented a new tool and a new counselling process. Enthusiastic teaching staff were motivated to begin the academic counselling process; although the process has not been without resistance from lecturers, both they and the students consider the tool to be useful and to facilitate understanding of the recommendations provided by the counsellors. The case of PUC-Chile differs from the above-mentioned cases in that it is oriented towards improving student engagement and performance in digital learning environments (MOOCs). The students value the tool positively and how it stimulates reflection, efficiency and effectiveness in the way they work during the courses.

In Table 4-52, the summary of the results obtained during the piloting is listed, following the order of the indicators described in Table 4-1. Although some of those involved have actively used the tools (Assets column), they are enabled for a much larger number of decision makers and students (enabled column).

Indicator	Overall Result	Institution	Results by Institution	
			Active	**Enabled**
A total of 300 decision makers are involved in the pilots (counselling and dropout tools)	650 decision makers participated in the pilots and 839 are enabled to do so.	UACh	22 decision makers (21 counsellors and the Undergraduate Director)	43 decision makers (42 counsellors and the Undergraduate Director)
		PUC-Chile	17 lecturers (NMP)	30 lecturers (NMP)
			3 lecturers (DaP-MOOC)	11 lecturers (DaP-MOOC)
		UCuenca	56 lecturers	74 lecturers
		ESPOL	416 counsellors	641 counsellors
		UChile	4	No information
		UPS	119	No information
		UFRPE	3	No information
		UZ	10	40
At least 5000 students in total involved in the pilots (counselling and dropout tools)	19.067 students in total were involved in the pilots and are 40.011 enabled to do so.	UACh	464 students	9085 students
		PUC-Chile	790 students (657 NPM online and 133flipped)	1.296 students (1054 NPM online and 242 flipped)
			2.421 students (DaP-MOOC)	5.319 students (DaP-MOOC)
		UCuenca	1.873 students	8.300 students
		ESPOL	9.485 students	12.631 students
		UChile	95	1252
		UPS	3668	No information
		UFRPE	112	No information
		UZ	159	2128

There are at least 8 institutions in Latin America that regularly use Learning Analytics tools to make informed decisions	8 universities have carried out the pilots. 4 of them are part of the consortium and another 4 are external to it.		
There are positive differences in the performance of students who receive counselling through the tools developed as a result of the project	There were positive effects on the performance of students who received counselling with LA tools. However, these improvements can be attributed to multiple factors, including the incorporation of LA tools	UACh	The tool helped the students involved to place in a higher position with respect to the ranking of their cohort
		PUC-Chile	The tool helped the students involved to complete the courses
		UCuenca	To be measured by the end of the semester
		ESPOL	The tool helped students improve their grades and better balance their academic workload
The advice and guidance of lecturers is more focused on the needs of each student, based on their data and that of previous students. Institutions use tools to predict or estimate outcomes based on mathematical/statistical/machine learning models and academic data.	Users have stated that they are satisfied with the tools and that they are highly usable. The tools have helped users to be more confident in explaining the decisions they make, to better guide students in planning their coursework and to use their time more efficiently. The use logs show that the users involved have actively used the tools	UACh	100% of the counsellors involved in the pilot project have used the tools, registering more than 7000 actions in them
		PUC-Chile	The tool was downloaded by 1054 students and in the online pilot users made 43,491 visits to the course materials
		UCuenca	62% of counsellors involved in the piloting have used the tools, registering 22.707 actions in them
		ESPOL	90% of the counsellors have used the new visualizations and it was consulted 23.546 times
The tools serve as an example for new ideas and implementations	The pilots have improved the tools (TrAC, AvAc, SiCa, Note My Progress and DaP-MOOC) and led to the design of new ones	UACh	TrACE was designed, a tool similar to TrAC but intended for students to plan the courses to enrol in
		PUC-Chile	It is expected that lecturer visualizations will be implemented that summarize what is happening in relation to the students' weekly planning and to support the students in this planning
		UCuenca	Two visualizations will be implemented to complement AvAc
		ESPOL	The data set for the calculation of the prediction was expanded and the visualizations of the prediction have been improved to incorporate explanatory information
Evidence-based decision-making is part of the culture of the universities in the LALA Community.	The results of the surveys and the use logs analysed at the 4 universities show that there is interest in continuing to use the tools after the pilots.	UACh	The resources were requested as part of TI's annual budget and supported by the Undergraduate Director. Progressively, new departments are being added that want to use the tools.
		PUC-Chile	The piloted tools are part of an institutional modernization initiative

	As specific evidence of the cultural change promoted by this project, the authorities have allocated resources for the institutionalization of the tools		supported by the director of the School of Engineering.
		UCuenca	Resources were allocated from the adaptation of the tool and continue to be allocated for improvements to be implemented. In addition, new faculties have been progressively added.
		ESPOL	The results of the deployment of the tools in SiCa were received positively by the Vice-Chancellor's Office and their institutional use will be encouraged

Table 4-34. Results by indicator

Although the results obtained in the pilots are not generalizable to every institution, because the adaptations and pilots were adjusted to the different contexts, they can be applied to similar contexts. In fact, the cases of UACh, Cuenca and ESPOL represent a wide spectrum of different realities with respect to academic counselling processes and tools in Latin America. In addition, the case of PUC-Chile serves as an example for those universities that wish to strengthen their initiatives in MOOCs. Table 4-53 shows the main lessons learned that have been collected during the pilots.

Effectiveness
The effect of the tools on the effectiveness of students is a difficult phenomenon to measure as it depends on multiple factors and isolating them is not a trivial task. Furthermore, for each institution the effectiveness of the students can be interpreted and measured differently. For example, in the UACh the effects of TrAC on the effectiveness of the students were measured using the ranking of the cohorts. It was concluded that the students who received counselling with TrAC, the following semester were in a better position in the ranking of their cohort with respect to their peers who did not receive counselling with TrAC. In the case of PUC-Chile, an experiment with a control group was designed to measure the effects of NoteMyProgress on students. This experiment allowed to observe a positive correlation between the active use of the tool and the completion of the MOOCs. In the case of UCuenca and ESPOL, effectiveness was measured through the difference between grades and the students' academic load balance, positive differences were obtained in both metrics. In summary, there were positive effects on the effectiveness of students who received advice with the LA tools. However, these improvements can be attributable to multiple factors, among which the incorporation of ML tools is considered.
Usefulness
The usefulness of the tools was measured through questionnaires, focus groups and / or interviews. In some of the universities, several of these strategies were used to triangulate the information. In all the universities the results were positive. In particular, users value the design attributes of the tools, their ease of use and, above all, their impact on their daily work. For example, some users mentioned that thanks to the tool they use their time more efficiently and that the information presented in the tools has helped users to explain the decisions they make with greater confidence. In addition, the tools have made it possible to better guide students when planning their dedication to courses. The logs of use of

the tools are concrete evidence that users have actively used the tools by performing multiple actions on them.
Institutional Impact
This aspect can be considered the most challenging. All the universities participating in the pilots presented difficulties at obtaining the commitment of the university authorities to actively participate and allocate resources in the institutionalization of the tools; materialize the exchange of data between existing applications in the university; support in the management of dilemmas related to data management, the possible interpretations of them and their impact on the intervened processes (counselling and self-monitoring). However, the project also raised awareness in the authorities regarding the importance and benefits derived from incorporating ML. This is materialized in various concrete actions, for example, at the UACh the Undergraduate Director supported the request for resources as part of the annual IT budget for the institutionalization of TrAC. In PUC-Chile, the piloted tools are part of an institutional modernization initiative supported by the director of the School of Engineering. In UCuenca, the rectory assigned resources for the adaptation of the tool and they continue to be assigned to improve implementations and gradually add new faculties. At ESPOL, the results derived from the use of SiCa were positively received by the vice-rector and its institutional use is encouraged.
Data and processes
All the pilot experiences highlight the importance of introducing an LA tool that is fed by existing learning data (e.g. academic records). While multiple ideas for designing the tools emerged during the needs assessment activities, restricting the pilots to the data currently captured by the institutions allowed for more effective execution and piloting. Likewise, the universities that introduced LA tools into existing more mature processes had to face less resistance in comparison with institutions with incipient or completely new processes such as UCuenca.
Team
The formation of a multidisciplinary team, which allows the promotion of socialization and involvement of key stakeholders in universities is essential to the success of the project. Therefore, it is recommended that stable teams with technical and management skills and with knowledge of the educational and institutional context be created.
Pilot preparation
A strategy used in most of the universities participating in the pilots has been to establish strong and trustworthy links with enthusiastic users, in order to spread the use of the tool among peers. These bonds of trust are strongly related to the quality of the tools and information provided. Consequently, it is recommended that the data and results delivered by the tools be analysed prior to any intervention with end users. In addition, it is crucially important to carefully define the messages and recommendations delivered with the tools.
User support
The design of tools with the active involvement of users allows for a considerable reduction in training efforts. However, during the pilot projects efforts should be made to provide the necessary guidance for users to make effective use of LA tools. In this way, possible biases can be avoided, and users can transform information into decisions and/or actions that positively influence learning and consequently the institution.

Socialization
At the beginning of the pilots, the importance of socializing and communicating the results obtained in the pilots within each university was underestimated. Therefore, it is recommended to continuously socialize and disseminate the results of the pilots with users and university authorities.
Adaptability
Due to the volatile Latin American social context, where strikes and social conflicts are frequent, it is essential to create the necessary adaptive capacity to address changing institutional priorities and/or needs for tool updates. Therefore, it should be kept in mind that the need to address changes in context (educational and social) and previously planned objectives must be reconciled.
Importance of piloting
The piloting of an LA tool is more than an experiment, it is a key activity for the adoption of the innovations. By means of a pilot project, the foundations are laid for effective adoption, during which the true applicability of the tools and the specific uses that stakeholders make of them can be understood. You can even identify the culture of the institution, its functioning, its needs and the changes that need to be encouraged to incorporate a process of improvement in data-based academic decision-making.

Table 4-53. Lessons learned from the piloting