Abstract	Learning analytics (LA) can provide useful information for addressing the educational needs in Latin American universities, such as reducing program quality disparities and student dropout rates. Some researchers have suggested to build capacity in this region for institutional adoption of LA tools. Yet, there is still a long way to move from experimentation to actual integration of LA tools into institutional processes. With the objective of understanding how we could facilitate LA adoption in Latin American contexts, we present the cases of four Latin American universities adapting LA tools to meet institutional needs. Two questionnaires with open-ended questions were used to identify similarities and differences among the four cases in terms of two dimensions: (1) leadership processes to involve diverse stakeholders in the adoption of LA tools and (2) organizational maturity to analyze and act upon educational data. Findings indicate that leadership processes for LA adoption that engage middle managers, such as deans and directors of undergraduate studies, facilitated the involvement of intended users to receive feedback on the design and of senior managers to allocate resources for scaling up the LA initiative. Besides, a greater organizational maturity facilitated the incorporation of the LA tool into an existing academic process at a department or institutional level. Future work might explore how leadership processes and organizational maturity evolve in other Latin American universities, in order to provide guidelines and recommendations for scaling LA adoption in different contexts.
Keywords (separated by " - ")	Learning analytics - Institutional adoption - Latin America - Higher education - Cross-case analysis - Leadership - Maturity

Chapter 16
Leadership and Maturity: How Do They Affect Learning Analytics Adoption in Latin America?

A Cross-Case Analysis in Four Latin American Universities

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16.1 Introduction

Higher education in Latin America has an urgent need for transformation, particularly in educating an increasingly diverse set of students (Ferreyra, Avitabile, Botero Álvarez, Haimovich Paz, & Urzúa, 2017; Knobel & Bernasconi, 2017; Reisberg, 2019). Although enrollment has expanded dramatically over the past two decades (Ferreyra et al., 2017), the region continues to adhere to a rigid and narrowly focused structure of programs (Knobel & Bernasconi, 2017; Reisberg, 2019). Latin American governments have implemented quality assurance policies to reinforce program improvement. However, a present issue is that not all universities have the capacity to continuously improve and innovate (Knobel & Bernasconi, 2017; Reisberg, 2019). As a consequence, students coming from socioeconomically disadvantaged backgrounds often have access to some lower-quality options, and an important percentage of them leave their programs in their first year (Ferreyra et al., 2017).

In this context, some researchers have suggested building capacity for institutional adoption of learning analytics (LA), so that Latin American universities can better leverage educational data to identify and meet students' needs (Cobo & Aguerrebere, 2018; Lemos dos Santos, Cechinel, Carvalho Nunes, & Ochoa, 2017). According to a recent study that assessed institutional needs for LA in Latin American universities, higher education stakeholders perceive that LA is a promising means for monitoring students' academic progress and workload at a curriculum level, in order to provide them with timely and personalized support (Hilliger et al., 2019). From current practice in the UK and other developed countries, researchers have argued that LA could become a valuable strategy for improving program quality, student performance, and retention rates (Gasevic, 2018; Sclater, Peasgood, & Mullan, 2016). As a result, there is growing interest in using LA to address similar educational challenges in Latin American and other developing countries (Gasevic, 2018; Sclater et al., 2016).

Although Latin American universities have started to measure and optimize teaching and learning processes through LA tools (Lemos dos Santos et al., 2017), there is still a long way to move from experimentation to full integration into institutional practice (Cobo & Aguerrebere, 2018). On the one hand, most efforts are still at an exploratory stage (Cobo & Aguerrebere, 2018), and most universities lack the maturity required for installing LA tools as an institutional capacity. On the other hand, only few universities have incorporated LA into institutional processes (Lemos dos Santos et al., 2017), which demonstrates a lack of leadership for pushing LA initiatives to address current educational needs. Considering that LA is still an emerging research field, its overall potential is higher than the actual evidence (Viberg, Hatakka, Bälter, & Mavroudi, 2018). Little is known about the leadership processes and the organizational maturity for adopting LA tools in diverse university settings. Thus, more cross-case studies are needed to understand how to transfer the potential of LA into universities with different levels of organizational maturity and leadership processes (Scheffel, 2017; Viberg et al., 2018).

To enlarge the literature on LA adoption in Latin America and understand how universities of this region could evolve from experimenting with educational data to institutional transformation, this study presents and analyzes the cases of four Latin American universities. In this analysis, the following research question is addressed: *how do leadership processes and organizational maturity in different Latin American universities affect the adoption of LA initiatives?* These cases are part of a multinational project funded by the European Commission Erasmus+ Program, LALA project (https://www.lalaproject.org/). The project aims to build institutional capacity for LA adoption in the region, and one of its objectives is to create or adapt LA tools for Latin American universities (Maldonado-Mahauad et al., 2018). Thus, the LALA project offers the opportunity to explore how different institutions adapted and adopted similar LA tools.

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. The leadership dimension is determined according to the definitions proposed by Dawson et al. (2018), which were built upon the complexity leadership theory (CLT) by Lichtenstein et al., (2006). This theory has been already alluded to in prior work to understand how leadership processes effectively lead to incorporation of LA tools at an institutional level (Tsai, Poquet, Gašević, Dawson, & Pardo, 2019). The organizational maturity dimension builds upon prior work conducted by Bichsel, (2012) and Siemens, Dawson, and Lynch (2013). These authors define organizational maturity as the capacity to work with educational data and develop LA tools to inform institutional practice. Further details about each case and its cross-analysis are explained in the next section, followed by the study findings and the lessons learned to facilitate LA adoption in Latin America. Thus, this study provides new evidence on the process of adopting LA in the Latin American context, aiming to contribute to it with useful insights about what it takes to move LA adoption forward in the region.

16.2 Methods

16.2.1 Research Design

In this study, we address the following research question: *how do leadership processes and organizational maturity in different Latin American universities affect the adoption of LA initiatives?* In order to answer this question, we followed a two-step procedure. First, we carried out a case study with four Latin American universities that had adopted LA tools at an institutional level. Second, we conducted a cross-case analysis to identify similarities and differences in terms of leadership processes and organizational maturity to analyze and act upon educational data.

16.2.2 Research Context

We chose four Latin America universities that are affiliated with the LALA project as our research context. These universities share a timeline for adapting and adopting similar LA tools, so it provides the opportunity to understand LA adoption in four different institutions in a common period of time. These universities differ in size, type of administration, and year of foundation, so their contrasts provided the opportunity to explore similarities and differences in organizational maturity and leadership processes. Also, two are traditional private universities in Chile and two are public universities in Ecuador, which allows comparing two different higher education systems.

- *Case 1: Adoption of NoteMyProgress in Pontificia Universidad Católica de Chile (PUC-Chile).* The PUC-Chile is one of the most prestigious pontifical universities in Chile and in Latin America. It was founded by a legislative decree in 1888, and it was conferred full academic and administrative autonomy in the late 1920s. Over the last century, it has become a large and selective institution, having currently 5 campuses and over 1200 full-time faculty members to serve 32,500 undergraduate and 5400 graduate students. Recently, this university started developing massive open online courses (MOOCs) and looking for new models to incorporate them as part of its regular programs. To support students in this process, 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).* The UACh is a nonprofit traditional private university in Chile. Since its foundation in the 1950s, the university has focused on expanding higher education in the southern region of the country, priding itself as a preponderant social actor in widening educational access. Currently, the university has 16,700 undergraduate students, 850 postgraduate students, and 750 full-time faculty members. Due to the socioeconomic characteristics of its students, one of the main problems of the university is the dropout rates of the first-year students, as well as the time students take for completing their degree programs. To deal with that, in the past 2 years, the institution has been working on the implementation of an LA solution for student academic counseling.
- *Case 3: Adoption of a redesigned academic counseling system in Escuela Politécnica del Litoral (ESPOL).* ESPOL is a public polytechnic university that was founded in Ecuador in the late 1960s. The university has a focus on engineering-related degrees across eight faculties. The main campus holds approximately 1000 full-time faculty members and 12,000 students, including 10,300 undergraduate and 1700 postgraduate programs. This university has been working, in the past years, on a students' counseling tool to reduce dropout and failing rates among its students.
- *Case 4: Adoption of dashboards in Universidad de Cuenca (UCuenca).* The UCuenca is a public institution located in the center of the south region of Ecuador. It was founded by a legislative decree in 1867. The university's mission

is to train professionals and scientists committed to improving the quality of life in intercultural settings and in harmony with nature. Currently, it has five campuses that count with about 1200 full-time faculty members, 16,600 undergraduate students across 12 faculties, and 930 postgraduate students. This university had no previous experience in LA at the time of the study, but their leaders recognized LA as a powerful tool to support students in their learning process. As a result, two LA dashboards have been introduced to provide teaching staff and counselors with information about students' curriculum progress and academic performance.

16.2.3 Data Collection

We collected data in two phases. The first phase involved sending a questionnaire to four researchers affiliated with the LALA project (one researcher per Latin American university) to collect information about the adoption of LA initiatives. The questionnaire consisted of the following open-ended questions:

- What educational need was intended to be addressed with the LA tool adopted at your institution as part of the LALA project?
- Who did you have to involve and convince to adopt this LA tool?
- What was the process you undertook to adapt and adopt the LA tool in your institution?
- Is the adoption of the LA tool meant to enhance any existing process of educational support?

In the second phase, a follow-up questionnaire was distributed to the same researchers who have participated in the previous stage. The researchers were invited to provide information about the stakeholders that were involved in the adoption of LA tools, the processes undertaken, and the results obtained in each of the four tool development phases (Broos et al., 2019):

- Diagnostic phase: this phase (narrowed down from the initiation phase in Broos et al., 2019) is dedicated to understanding institutional needs for LA tools.
- Design/prototyping phase: this phase is dedicated to designing LA tools that can meet the needs identified in the diagnostic phase.
- Piloting phase: this phase is dedicated to piloting LA tools and evaluating the results.
- Scaling-up phase: this phase is dedicated to identifying actions that can embed the adopted LA tools into institutional processes.

In order to gain a comprehensive view of LA adoption in the four institutions, we triangulated the data collected from the two questionnaires with project documentation, including technical information and instructions about the adopted tools (https://www.lalaproject.org/demo/) and the project deliverable titled "Design of Learning Analytics Tools" (http://bit.ly/35yS93A).

16.2.4 Data Analysis

The data analysis also consisted of a two-step procedure. The first step was to analyze individual cases and create a detailed description of the tool development process. We hand-coded the answers to the two questionnaires with respect to the institutional need addressed by the tool developed, the stakeholders involved throughout the process, the processes undertaken for tool deployment, and the results obtained from each phase. The codes used were stakeholders, leadership processes (bottom-up and top-down), implementation phases (diagnostic, design/prototyping, piloting, and scaling up), and maturity of the tool implemented.

The second step involved a cross-case analysis to identify similarities and differences regarding (1) leadership processes to involve diverse stakeholders in LA tool adoption and (2) organizational maturity to analyze and act upon educational data. For this step, we used a schema to represent the current state of LA adoption in each university in terms of leadership processes and organizational maturity (see Fig. 16.1). The leadership axis indicates a spectrum between top-down and bottom-up leadership processes defined by Dawson et al., (2018) and inspired by the complexity leadership theory (CLT) by Lichtenstein et al. (2006). The top-down processes correspond to LA initiatives that are mainly led by senior managers such as vice provosts, without necessarily involving LA ground-level staff throughout the tool development process. In contrast, a bottom-up process corresponds to LA initiatives mainly led by ground-level staff, such as researchers, teaching staff, and counselors, without necessarily involving senior managers throughout the tool development processes. Organizational maturity is described as the capacity to

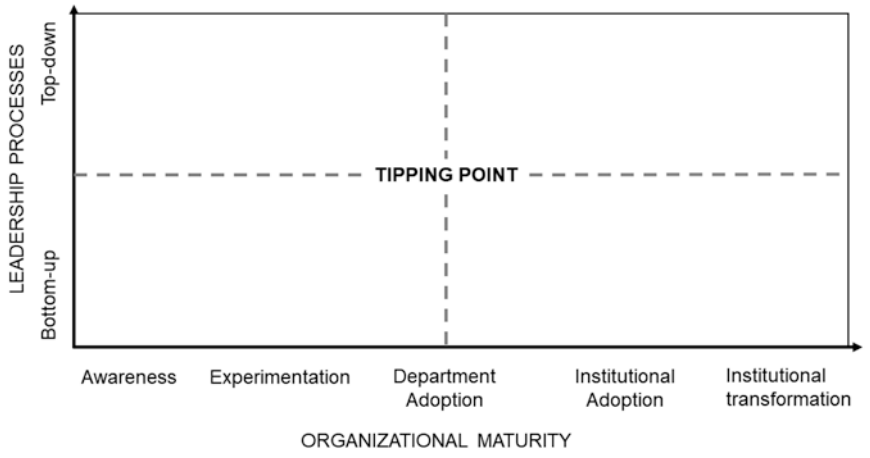

Fig. 16.1 Schema for comparing the current state of LA adoption in different institutions in terms of leadership processes and organizational maturity to analyze and act upon educational data. The tipping point indicates the state in which both senior managers and ground-level staff are interacting to effectively adopt an LA tool at a department level

work with educational data and develop LA tools to inform institutional practice (Bichsel, 2012). 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)

16.3 Case Descriptions

Each one of the following subsections describes one of the cases selected for the cross-case analysis. Each case presents the leadership processes conducted for institutional adoption of LA tools, besides describing institutional aspects that reveal the organizational maturity for working with educational data and developing LA tools to inform institutional practice.

16.3.1 Adoption of NoteMyProgress in PUC-Chile

In PUC-Chile, LA researchers designed and implemented a tool called NoteMyProgress (NMP). This tool aims to support students' self-regulation strategies, in order to help them succeed in MOOC-based institutional initiatives. Through interactive visualizations, NMP offers aggregated data about the students' activity in the online courses and interactions with the course contents (see Fig. 16.2).

The need for designing and implementing NMP emerged from three research projects conducted by a researcher in the institution that aimed to understand student self-regulation strategies in MOOC-based initiatives. These three projects were also related with an institutional initiative launched in PUC-Chile to develop MOOCs using the Coursera platform and hybrid educational models to integrate them into traditional courses. Therefore, the interest of this LA initiative, in which data for MOOCs was leveraged at institutional level, was twofold: to understand students' self-regulated learning strategies and to propose solutions for promoting strategies to help students succeed in MOOC-based institutional initiatives.

The NMP was designed following the interactive learning design (ILD) framework created by Bannan, (2003). Table 16.1 summarizes all the phases followed for

Fig. 16.2 Screenshot of the NoteMyProgress (NMP) tool, a learning analytics tool proposed at the Pontificia Universidad Católica de Chile (PUC-Chile) to support and promote students' self-regulatory abilities to help them succeed in MOOC-based institutional initiatives

the adoption of NMP, from the diagnostic to the scaling-up phase. During the *diagnostic phase*, the researchers who were LALA project representatives conducted a literature review on analytical solutions for supporting self-regulatory strategies in online settings. With the results of this review, they developed the first version of the tool (Pérez-Álvarez, Maldonado-Mahauad, & Pérez-Sanagustín, 2018). In the *design/prototyping phase*, a first prototype of NMP generated 2 instrumental case studies for evaluating its usability and usefulness, one with 3 experts and 7 students affiliated to PUC-Chile and another one with 126 students from 10 different countries who registered in 3 MOOCs developed in PUC-Chile. The results of these instrumental case studies informed a new version of the tool ready to be tested in actual MOOC-based initiatives. Then, in the *piloting phase*, two pilots were proposed. The first one was conducted on three MOOCs created by PUC-Chile, collecting information from 236 students all over the world. The second one was conducted in four courses in Coursera created by Universidad de Chile. The results of the first pilot provided evidence on the effectiveness of this tool in supporting self-regulatory abilities in MOOC-based institutional initiatives. This evidence was used by LALA project representatives to start conversations with the dean and the associate dean for engineering education in PUC-Chile, initiating the *scaling-up phase*. The main objectives in this phase is to install NMP as a service of the engineering education unit, considering that the PUC currently offers 91 MOOCs with about 410.00 students enrolled. AU4

Table 16.1 Phases for the adoption of the analytical tool NoteMyProgress in PUC-Chile

Phases	Stakeholders involved	Processes undertaken	Results obtained
Diagnostic	LA researchers at PUC-Chile	Literature review on learning analytics tools for supporting self-regulated learning strategies	Requirements for an LA tool to develop students' strategies for self-regulated learning in MOOC-based initiatives.
Design/ prototyping	LA researchers at PUC-Chile LA experts and students from PUC-Chile Students from different countries	Design-based approach based on two instrumental case studies	A first version of a tool for the development of self-regulated learning skills
Piloting	LA researchers at PUC-Chile and Universidad de Chile Students from different countries	Evaluation of tool implementation in PUC-Chile and Universidad de Chile	Data collected from online and face-to-face activities to evaluate the use of the tool in different educational settings
Scaling up	Dean of engineering school at PUC-Chile Associate dean for engineering education at PUC-Chile Managers and teaching staff from PUC-Chile and other universities	Discussion with PUC-Chile staff and staff from other universities about the implementation of new experiences of the tool, besides installing it as a service in PUC-Chile engineering education unit	Proposal for scaling up the implementation of the tool at PUC-Chile and other universities

Each phase includes information about the involved stakeholders, the undertaken processes, and the obtained results

16.3.2 Adoption of TrAC in UACh

In UACh, LA researchers developed an analytical tool called TrAC to support program chairs in their responsibility to lead academic counseling processes. TrAC provides program chairs with information about students' academic progress in relation to the curriculum study plan and their academic performance. Figure 16.3 shows the dashboard provided to program chairs by TrAC, in which they can visualize the courses a student has to take, highlighting in green those that the student has already passed and in red those that the student failed. The main aim of this LA solution is to help program chairs identify students who are at risk of falling behind and eventually dropping out of a study program, in order to offer them timely support.

Fig. 16.3 Screenshot of the TrAC, a counseling LA tool developed at the Universidad Austral de Chile (UACh). This visualization shows the study plan of a student, highlighting in green those courses that the student has already passed and in red those that the student failed

AU6

TrAC was developed in the context of the LALA project, and its design was based on the LISSA dashboard developed in KULeuven (Charleer, Moere, Klerkx, Verbert, & Laet, 2018). In order to adapt LISSA to the UACh context, LA researchers followed an agile software development lifecycle (Chevreux, Henríquez, Guerra, & Sheihing, 2019) involving different stakeholders in a participatory design process. Table 16.2 summarizes all the phases followed for the design and implementation of TrAC.

During the *diagnostic phase*, the researchers who were LALA project representatives coordinated a set of participatory activities (as described in the institutional dimension of the LALA framework developed by Pérez-Sanagustín et al. (2018)), including interviews, focus groups, and questionnaires with different stakeholders: the learning support unit, academic registration unit, the IT office, and the different schools and program chairs. The results of this phase lead to a set of needs and requirements for the tool adaptation, besides identifying data access and privacy issues to be addressed throughout the following tool development phases. During

Table 16.2 Phases for the adoption of the analytical tool TrAC in UACh t2.1

Phases	Stakeholders involved	Processes undertaken	Results obtained
Diagnostic	LA researchers at UACh Teaching staff Students Program chairs Director of undergraduate studies IT office Learning support unit	Participatory activities, interviews, focus groups, and questionnaires conducted in the context of the LALA project	Needs for an LA tool to help students to make informed decisions based on their academic trajectory
Design/ prototyping	LA researchers at UACh Program chairs Director of undergraduate studies IT office Learning support unit Academic registration unit	Agile software development lifecycle based on iteration and semi-functional prototypes	Validated design of the TrAC tool (including data integration)
Piloting	Program chairs/ teaching staff IT office	Surveys and focus groups with program chairs	Data collected to evaluate the use of the tool
Scaling up	Program chairs/ teaching staff Students Director of undergraduate studies Learning support unit IT office Dean of engineering school	Collaborative work among LA researchers, the IT office, and the director of undergraduate studies	Proposal for wide adoption of the tool, including students as new users

For each phase, this table shows the stakeholders involved, the processes undertaken, and the results obtained t2.41 t2.42

the *prototyping phase*, these researchers coordinated several codesign sessions in which semi-functional prototypes were evaluated in order to develop, incrementally, a first functional prototype of the tool. The key stakeholders in this phase were the program chairs (intended final users) and the director of the undergraduate studies. This last actor played a key role, because he facilitated the socialization of the tool with the learning support unit, the academic registration unit, the IT office, and the program chairs of different faculties. At the end of this phase, a functional

prototype of the tool was obtained for the *piloting phase*. In this phase, 17 program chairs used TrAC during course enrollment and withdrawal. The IT office was also involved as the stakeholder in charge of solving technical problems and registering possible improvements for next versions of the tool. At the end of this phase, data was collected and analyzed for analyzing the tool implementation. After the piloting phase, the data collected was analyzed for tool improvement, in order to scale it up at an institutional level. Therefore, LA researchers are still working with the IT office and the director of undergraduate studies in the *scaling-up phase*, in order to adopt the tool at an institutional level.

16.3.3 Adoption of the Redesigned Academic Counseling System in ESPOL

In ESPOL, teaching staff had already an academic counseling system to help students with course enrollment and academic planning. This system provided teaching staff with valuable information, such as a report about the courses taken by students (academic history) as the one shown in Fig. 16.4. However, this system did not provide enough data nor visualizations to help teachers see the academic history of students and plan the courses for the upcoming semester, so it did not allow teaching staff to guide students as they enroll courses for the upcoming semester. Given this situation, the researchers who were LALA project representatives decided to develop new visualizations to improve this tool. Table 16.3 summarizes all the phases followed for the adoption of the new visualizations for the academic counseling system.

Este servicio es consultado en línea, la información es tomada del Sistema Académico de la E.S.P.O.L.

Historial académico en línea — Buscar:

Año	Término	Materia	Promedio	Vez Tomada	Nota 1	Nota 2	Nota 3	Estado	Profesor
2017	2S	DESARROLLO DE APLICACIONES WEB	9.8	1	97.0	97.0	0.0	APROBADA	
2017	2S	INTERACCIÓN HUMANO COMPUTADOR	8.78	1	90.0	82.0	0.0	APROBADA	
2017	2S	METODOLOGÍA DE LA INVESTIGACIÓN EN COMPUTACIÓN	9.05	1	89.0	92.0	0.0	APROBADA	
2017	2S	PROCESAMIENTO DIGITAL DE IMÁGENES	8.85	1	93.0	84.0	0.0	APROBADA	
2017	2S	SISTEMAS DE INFORMACIÓN	8.9	1	92.0	86.0	0.0	APROBADA	

Fig. 16.4 Screenshot of the academic history report in the existing academic counseling system in the Escuela Superior Politécnica del Litoral (ESPOL)

Table 16.3 Phases for adoption of the new visualizations for the academic counseling system in ESPOL

Phases	Stakeholders involved	Processes undertaken	Results obtained
Diagnostic	LA researchers at ESPOL Vice provost for academic affairs Other institutional leaders Teaching staff Students	Participatory activities, interviews, focus groups, and questionnaires conducted in the context of the LALA project	Needs for redesigning the visualizations of the existing academic counseling system
Design/ prototyping	LA researchers at ESPOL Teaching staff	Use of an iterative methodology for software design based on design thinking principles	A first version of the new visualizations
Piloting/ scaling up	Teaching staff	Application of knowledge test and a pretest survey to collect information about tool visualization satisfaction, usability, and functionalities at the end of the training session offered to all teaching staff members	Data collected about the tool usability and the need for improvements
		Implementation of the new visualizations in the existing academic counseling system Posttest survey about tool visualization satisfaction	Data collection from teachers' perception and log files usage

For each phase, this table shows the stakeholders involved, the processes undertaken, and the results obtained

To redesign the system, the researchers who were LALA project representatives adopted an iterative and user-centered methodology, which combined design thinking concepts with human computer interaction (Ortiz-Rojas, Maya, Jimenez, Hilliger, & Chiluiza, 2019). Firstly, in the *diagnostic phase*, these researchers involved the vice provost for academic affairs to obtain his approval for educational data gathering and his support for the system redesign. They also involved teaching staff, students, and other middle managers in participatory sessions, including focus groups, interviews, and questions (as described in the institutional dimension of the LALA framework developed by Pérez-Sanagustín et al. (2018)). As a result of this phase, a list of needs was collected and translated into requirements for a new version of the tool. Secondly, the researchers started the *design/prototyping phase*, in which they run several meetings with teaching staff. The meetings were organized following a methodology based on design thinking principles, providing staff members with different prototypes of visualizations to capture teaching staff perspectives.

Figure 16.5 presents a screenshot of the new visualization developed after iterating different prototype versions, which provides teaching staff with information about the study plan of their students. For every student, this new visualization

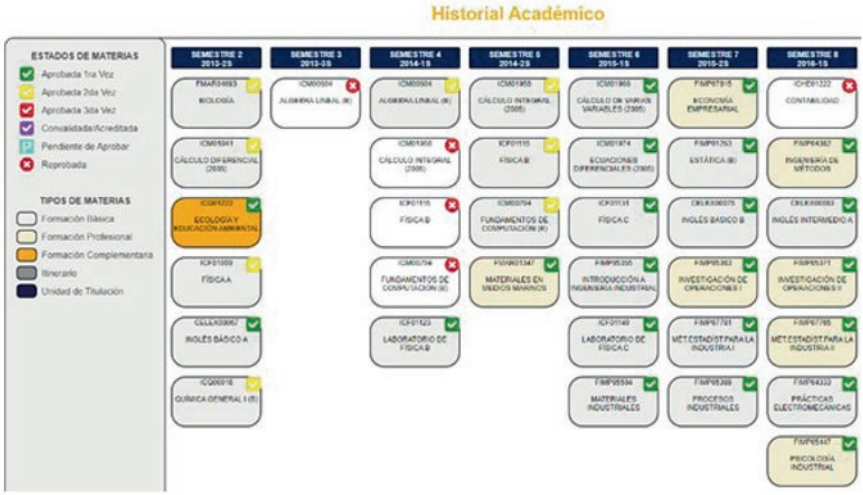

Fig. 16.5 Screenshot of the new visualization of the academic history in the counseling system adopted at the Escuela Superior Politécnica del Litoral (ESPOL). The green check mark highlights those courses of the study plan that the student passed in the first sitting, the yellow one those the student passed in the second sitting, and the red cross those the student failed

highlights courses passed at first chance with a green checkmark, those passed at second chance with a yellow one, and those failed with a red cross. This new visualization evolved directly from a tool design phase to a *piloting/scaling-up phase*, because the vice provost requested the LALA project representatives to scale up the new version tool to the entire teaching staff. To avoid anxiety issues due to the changes in the current visualizations, all teaching staff members were invited to a face-to-face training session to help them use the new visualizations. This training session helped teaching staff to understand the need for redesigning the system, and they ended up convinced that the change was beneficial for students. LA researchers collected data at the end of the training session and after the tool was implemented across faculties, and the results show that teaching staff satisfaction increased with the implementation of the new visualizations.

As a consequence of the positive results, the LA researchers have already incorporated the new visualizations into the current academic counseling system, and these visualizations have already been used by approximately 300 teaching staff (who advise about 7000 students). In order to help students, the new visualizations are being used at the beginning and in the middle of each of the semester, and it is expected to evaluate further adoption of the tool by means of log data analysis and teaching staff feedback.

16.3.4 Adoption of Dashboards in UCuenca

In UCuenca, both decision-makers and researchers coordinated an LA initiative for developing a counseling dashboard from scratch, aiming to deal with first-year dropout rates. Since the university had no previous experience in LA, LALA project representatives decided to work collaboratively with the dean and the associate dean of the engineering faculty, in order to at least have department-level support for the adoption of this initiative. Table 16.4 summarizes all the phases followed for the adoption of this dashboard, which were also based on the LISSA dashboard developed in KULeuven (Charleer et al., 2018).

Table 16.4 Phases for the adoption of dashboards in UCuenca

Phases	Stakeholders involved	Processes undertaken	Results obtained
Diagnostic	LA researchers at UCuenca Dean of the engineering faculty Associate dean of the engineering faculty Program chairs of the engineering faculty IT director Teaching staff Students	Participatory activities, interviews, focus groups, and questionnaires conducted in the context of the LALA project	Needs for an LA tool to support the counseling process
Design/ prototyping	LA researchers at UCuenca Engineering students Engineering teaching staff Program chairs of the engineering faculty IT office Rector	Design-based approach based on several iterations with low-fidelity and high-fidelity prototypes	A first beta version of the dashboards
Piloting	LA researchers at UCuenca Students Faculties: engineering chemical sciences, hospitality sciences, economic and administrative sciences Teaching staff of the faculties: engineering chemical sciences, hospitality sciences, economic and IT office	Integrating the use of the dashboards in the faculties: engineering, chemical sciences, hospitality sciences, economic and administrative sciences Faculties' staff has been trained. Some people think using the tools could represent an additional workload	Data collected about the tool usability and the need for improvements
Scaling up	Program chairs/teaching staff Students Institutional leaders	Adaptation of the dashboards to the requirements of other faculties	Project proposal for institutional adoption

During the *diagnostic phase*, the LALA project representatives conducted different participatory activities, including questionnaires, focus groups, and interviews, with program chairs, teaching staff, students, and the IT director (as described in the institutional dimension of the LALA framework developed by Pérez-Sanagustín et al. (2018)). In addition to identifying the need for a counseling tool, the process of data collection was an opportunity to raise awareness about the potential of leveraging educational data. As a result, the IT staff got also involved, helping with data availability and technological resources. As a result of this phase, the LALA project representatives developed a report with the requirements for designing a counseling dashboard to provide teaching staff, counselors, and program chairs with information about students' academic progress.

During the *design/prototyping phase*, researchers developed two dashboards: one for teaching staff and another one for counselors and program chairs. Firstly, the teaching staff dashboard provides teachers with information about the academic performance of the students in their course, so that they can implement actions to support students at risk of failing their courses. Figure 16.6 shows a screenshot with the information provided in this case. In particular, it shows a line for each of the students registered in a course and their performance in the course evaluations. Secondly, the counselors' dashboard provides academic information about the students' performance and progress according to their study plans. Figure 16.7 shows the study plan of a particular student, highlighting courses passed with a green line, courses failed with a red line, and courses currently being taken with a blue line. This dashboard also includes visualizations of the students' grade point average and the number of courses taken per semester. The idea was to provide information to

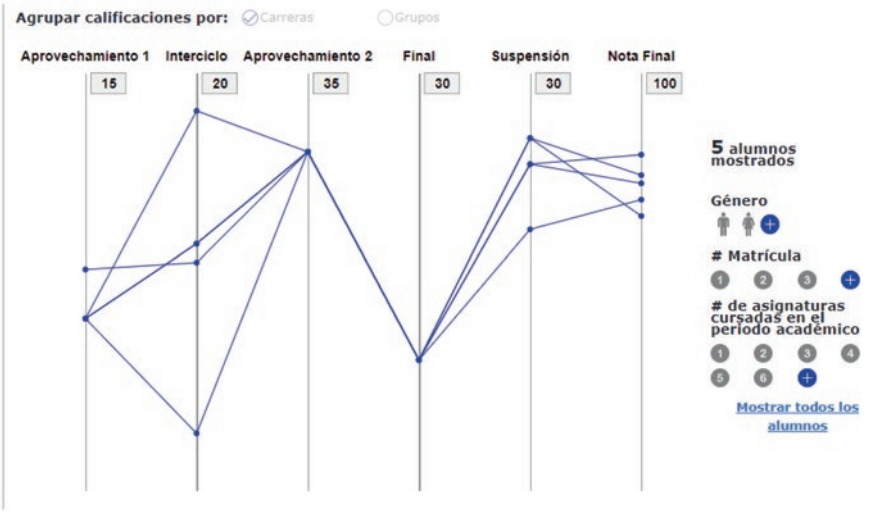

Fig. 16.6 Screenshot of the teaching staff dashboard developed by the Universidad de Cuenca (UCuenca). Each line corresponds to a student registered in the course, showing his/her performance in different assessment methods

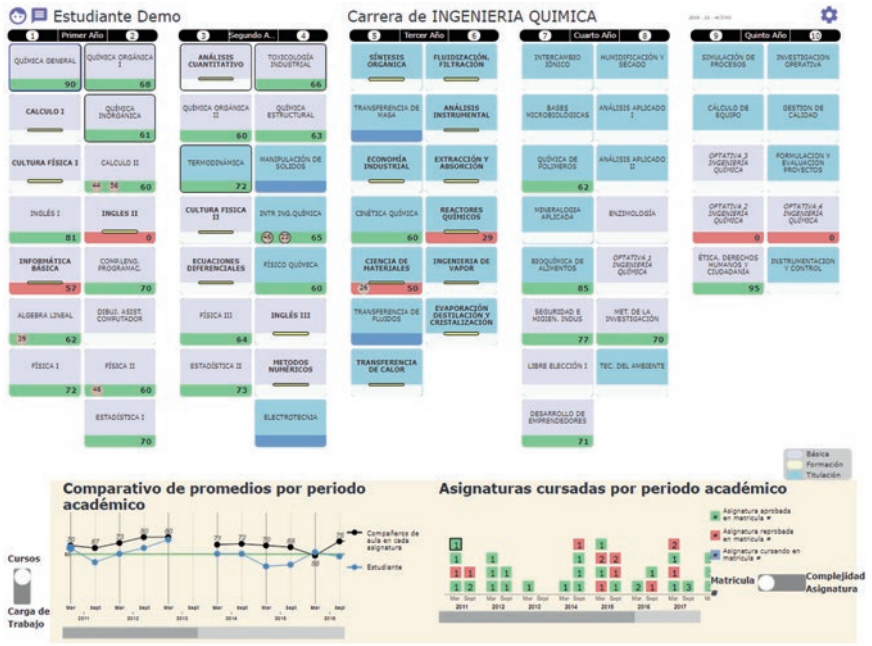

Fig. 16.7 Screenshot of the counselor dashboard developed by the Universidad de Cuenca (UCuenca). On the top, it shows different courses of the study plan, highlighting courses passed with a green line, courses failed with a red line, and courses currently being taken with a blue line. At the bottom, it shows students' grade point average and the number of courses taken per semester

the counselors and program chairs, so they can help students to make informed decisions regarding course enrollment and academic planning.

After several iterations, the LALA project representatives and the IT office had enough information to develop a first functional tool. This tool was presented to the rector to ask for support for the piloting phase. Although the *piloting phase* has not been conducted yet, researchers have already prepared a plan to pilot the two dashboards in four faculties, using real data of students' academic performance. The teachers' dashboard will be used by the engineering teaching staff, where each staff member will have access to academic information of the students enrolled in their courses. The counseling dashboard is planned to be used in counseling sessions among four program chairs and students enrolled in their programs. In this phase, the researchers affiliated to the LALA project will collect data before and after piloting, with the aim of understanding the impact of using the tool. If there is wide acceptance of the tool, the researchers plan to move forward to the *scaling-up phase* by promoting the use of the dashboards in other faculties. However, researchers already anticipate some barriers in this last phase, due to the lack of LA culture in the institution and the need for institutional processes in order to integrate the use of the dashboards into the daily practices of teaching staff, counselors, and program chairs.

16.4 Findings of Cross-Case Analysis

The cross-case analysis shows that the four cases differ in terms of leadership processes and organizational maturity. Figure 16.8 illustrates these differences by locating each case in a different position of the schema that we developed to represent the current state of LA adoption in diverse institutions. The location on the y-axis represents the leadership process implemented to involve stakeholders during tool development phases, while the x-axis represents the level of organizational maturity to incorporate the tool into institutional processes. Further analysis of how the leadership process and the level of maturity of each university affected LA adoption is addressed in the following subsections

16.4.1 Leadership

The cross-case analysis indicates that the leadership processes to involve stakeholders affected the progress of tool development phases in each university setting. In the case of PUC-Chile, the LA initiative emerged from a bottom-up process led by a researcher in the context of an experimentation. The predominance of ground-level staff facilitated tool development from the design to the piloting phases. However, the lack of involvement of other senior stakeholders in the process, such as vice provosts or deans, hindered tool scaling at an institutional level. The other extreme is the case of ESPOL, in which the LA initiative emerged as top-down process led by the vice provost. This top-down process facilitated the institutional support needed for redesigning the existing academic counseling system. Yet, the lack of involvement of teaching staff members in the decision-making processes generated some anxiety during the piloting/scaling-up phase, since the initiative

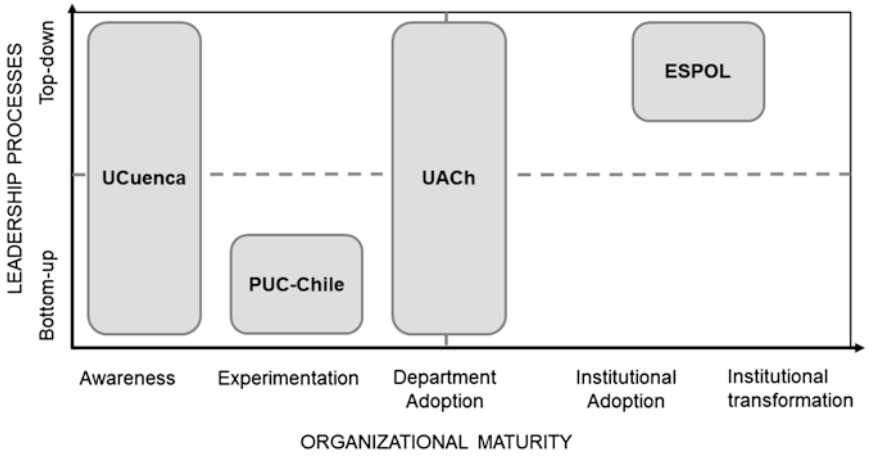

Fig. 16.8 Schema of the comparison of the four cases in terms of leadership and maturity levels

was presented as an institutional change that they had to accept across faculties. Then, the cases of the UACh and UCuenca are more balanced, considering that they combined bottom-up and top-down leadership processes to involve different stakeholders throughout the tool development process. In both cases, middle managers played crucial roles – such as the director of undergraduate studies in UACh or the associate dean of the engineering faculty in UCuenca. They not only involved other key stakeholders during the design and piloting phases, such as the program chairs and the IT director, but also placed a high priority on ensuring that the LA initiative met an institutional need. This confirms the importance of responsive leadership to create favorable environments to transfer the integration of LA tools into institutional processes (Dawson et al., 2018; Tsai et al., 2019).

16.4.2 Organizational Maturity

The cross-case analysis indicates that the organizational maturity of each university affected the leaders' capacity to incorporate the LA initiatives into existing institutional processes. In the case of UCuenca, the university leaders were aware (awareness level) of the promising use of LA tools, but they had no prior experience with LA applications. As a consequence, they faced challenges to determine which institutional processes would benefit from the use of the teachers' and counselors' dashboards they designed. At the PUC-Chile, the stakeholders involved had already some experience in managing and analyzing data collected from the students' interaction with MOOC content (experimentation level), but they faced challenges to scale up the tool as an institutional service for engineering departments. On the contrary, these challenges were not observed in the cases of UACh and ESPOL, which had a higher organizational maturity in terms of analyzing educational data to inform institutional practice. In both cases, the stakeholders involved in the project had already identified challenges in their academic counseling processes as an evidence-based practice that could benefit from the use of an analytical tool. Moreover, both institutions adopted an LA tool to help students with course enrollment and academic planning (Gasevic, 2018), aiming to boost retention rates as a consequence of supporting students' decision-making at an early stage (Sclater et al., 2016). So far, UACh has only widened adoption at a department level (department adoption), whereas ESPOL has scaled up their system to an institutional level (institutional adoption).

16.5 Lessons Learned and Conclusion

This study has briefly outlined four cases of LA initiatives conducted in Latin American universities in four phases: (1) diagnostic, (2) design/prototyping, (3) piloting, and (4) scaling. We used a cross-case analysis as the methodology to

identify similarities and differences across the four cases. This analysis was based on prior LA studies that used the complexity leadership theory to better understand the role of leadership processes and organizational maturity on the adoption of LA initiatives at an institutional level. On the one hand, findings indicate that the leadership processes affected tool development progress in each university setting. On the other hand, the level of organizational maturity of each university affects their leaders' capacity to identify institutional processes that could incorporate LA tools.

In order to transfer the potential benefits of LA into higher education practice, we identified a tipping point in the institutional adoption of LA initiatives. This tipping point represents the moment in which university leaders have identified at least one academic process that could benefit from using an LA tool, along with the combination of bottom-up and top-down leadership processes to engage diverse stakeholders throughout the tool development phases. In the schema that compares the four cases (see Fig. 16.8), UACh is located across the y-axis because it illustrates this point in which different stakeholders had already identified an existing process to incorporate an analytical tool (the student counseling process). By engaging middle managers, such as the director of undergraduate studies and the director of the IT office, UACh researchers have been capable of developing a tool that is smoothly transiting to being scaled up at an institutional level. According to the implications of these findings, LA project representatives need to collaborate with middle managers, considering that they play a key role in facilitating the involvement of ground-level staff and senior managers throughout the different tool development phases.

From the systematic case description and the cross-analysis conducted, we extract two lessons learned that might guide other higher education institutions on how to start an LA initiative. First, it is recommended to consult a variety of stakeholders about institutional needs in order to identify an existing process that benefits from the use of LA. This consultation processes will not only raise awareness on the potential of LA tools among diverse stakeholders but also serve as a trigger for initiating an institutional cultural change toward the use of data for supporting evidence-based decision-making. Second, it is recommended to combine bottom-up and top-down leadership processes to move tool development forward – from its conceptualization to its institutional adoption. This approach implies engaging middle managers – such as deans, IT director, and undergraduate studies director – throughout tool development phases, so they can place a high priority on developing and promoting an LA initiative at an academic unit, in addition to involving other key stakeholders such as IT staff and program chairs.

Although the cross-case analysis presented in this study was supported on a theoretical basis, there are limitations that should be taken into consideration before the findings and lessons learned are extended to other Latin American contexts. Considering the limited number of LA initiatives in the region, it is currently challenging to evaluate to what extent the four universities represented in this study are similar to or different from other higher education institutions all over Latin America. In order to address this limitation, we examined universities that differ in size, type of administration, and year of foundation, representing contrasting higher

education systems. Besides, the cross-case analysis was based on LA literature, interpreting prior work conducted by Bichsel (2012), Siemens et al. (2013), and Dawson et al. (2018).

Still, future work should analyze how the graphical schema presented in this chapter represents different LA initiatives in different Latin American universities for further generalization of the lessons learned. In order to better understand implications and mechanisms of adopting LA tools in varied contexts, more research is required to evaluate how this schema applies for planning, analyzing, and comparing LA initiatives in other universities. Still, the findings presented in this chapter extend the current research on LA adoption in Latin American universities by analyzing how LA tools are designed and implemented in different institutions of the region, exploring the implications of LA adoption in terms of leadership and organizational maturity.

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