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Adaptation and evaluation of a learning analytics dashboard to improve academic support at three Latin American universities

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Abstract

Despite the success of academic advising dashboards in several higher educational institutions (HEI), these dashboards are still under-explored in Latin American HEI's. To close this gap, three different Latin American universities adapted an existing advising dashboard, originally deployed at the KU Leuven to their own context. In all three cases, the context was the main ruling factor to these adaptations. In this paper, we describe these adaptions using a framework that focuses on four different elements of the context: Objectives, Stakeholders, Key moment and Interactions. Evaluation of the adapted dashboards in the three different Latin American universities is conducted through pilots. This evaluation shows the value of the dashboard approach in different contexts in terms of satisfaction, usefulness and impact in academic decision-making and advising tasks. The main contribution of this paper is the systematic reporting of the adaptations to an academic advising dashboard and showing the value of an academic advising dashboard on academic decision-making and advising tasks.

Introduction

Academic advising dashboards use academic data, such as courses passed and failed and grades, to support decisions such as course registration. Charleer, Moere, Klerkx, Verbert, and De Laet (2018) and Millecamp, Gutiérrez, Charleer, Verbert, and De Laet (2018) show how a well-designed dashboard triggers conversation, motivates the student and supports insights into face-to-face advisor–student sessions. However, dashboards for academic advising are under-explored in Latin American (LATAM) higher education institutions (HEI). In addition, although several interesting learning analytics solutions have been elaborated in recent years, there are currently not many reports of deployment at institution-wide scale (Dawson, Joksimovic, Poquet, & Siemens, 2019; Ferguson *et al.*, 2014). Broader institutional implementation introduces new challenges related to resistance to change (Ferguson *et al.*, 2014).

To overcome these challenges, the LALA Project (*Learning Analytics in Latin America*), an Erasmus+ project to build capacity for learning analytics in LATAM HEI, elaborated a framework that enables the development and deployment of learning analytics (Maldonado-Mahauad *et al.*, 2018). Four LATAM institutions collaborated with three European institutions to diagnose needs, adapt tools and pilot learning analytic experiences. Interviews and focus groups performed during the diagnosis phase of the LALA Framework (Hilliger *et al.*, 2019) revealed that academic advising was a recurrent need for which data were available (Sanagustín *et al.*, 2019). Thus, three LATAM partners selected academic advising as the main focus of effort. The University of Leuven, a European LALA partner, provided LISSA (Charleer *et al.*, 2018) as a baseline dashboard

Practitioner Notes

What is already known about this topic

- Learning analytic dashboards for academic advising support student–advisor dialogs and academic decision making.
- Academic advising dashboards are under-explored, and there is no report in the learning analytic community about cases in Latin America.

What this paper adds

- Three Latin American cases adapt and pilot dashboards for academic advising, covering a broad range of different institutional and academic advising contexts.
- Context can be dissected and analysed by focusing on objectives, stakeholders, key moments and interactions.

Implications for practice and/or policy

- To adopt learning analytics consider adapting tools for existing data and for already established processes.
- Adaptations of academic advising dashboards need to look at when the advising happens, with which goal, and how it happens in terms of the interaction of advisors and students.

to initiate adaptations. In this scenario, efforts were put in adapting the original tool to the different contexts. The work attempts to answer the following research questions:

RQ1: How does the context of Latin American HEIs influence the adaptation of an advising dashboard designed in a European University?

RQ2: How do the adapted dashboards support advising processes in the LATAM institutions?

We present cases of the three LATAM Institutions adapting and piloting an academic advising dashboard. Third section presents methods used to analyse and present adaptations, and the methods behind the pilots evaluating the dashboards. Specific details of each case and their contexts are introduced in fourth section, and details of dashboards and their adaptations are given in fifth section. Sixth section presents results of the pilots. Seventh section discusses the results, and eighth section summarises conclusions.

Related work

Universities are collecting vast data that provide rich opportunities to provide better advising support for students, such as predicting student performance and retention (Papamitsiou & Economides, 2014). A key focus in learning analytics is to put this information in the hands of human experts to support decision making (Lonn, Krumm, Waddington, & Teasley, 2012). The objective is to inform and to empower academic advisors, instructors and students of issues that are identified by data mining techniques and to leverage human judgement (Siemens, 2012). Most learning analytics tools either support teachers or students, or a combination of both (Verbert *et al.*, 2014).

While academic advisors are key stakeholders (Drake, 2011), little research has been done so far to use dashboards to support academic advising (Gutiérrez *et al.*, 2018). A notable exception is the LISSA dashboard that supports the advisor–student dialogue, motivated students positively and triggered conversations and personalisation during the advising session (Charleer *et al.*, 2018). *EAdvisor* is a combination of both a student and a staff-facing tool developed by the Arizona state

university to support the choosing of a major and courses (Phillips, 2013). Aguilar, Lonn, and Teasley (2014) designed *Bridge*, an advisor-facing tool intended to provide academic advisors with access to the achievement and engagement data of students. Fritz (2011) discussed the development and deployment at the University of Maryland-Baltimore of the *Check My Activity dashboard* that supports students' awareness of how their use of the learning management system and their current grades compares to that of their peers.

Although these examples are promising for academic advising, there are currently not many reports of deployment at institution-wide scale (Ferguson *et al.*, 2014). Broader implementation introduces new challenges related to resistance to change (Ferguson *et al.*, 2014). Dawson *et al.* (2019) indicate that many research efforts are "small-scale techno-centric exploratory studies" and that the field must move to "more holistic and integrative systems-level research". There is a need to better document case studies that supported educational institutions in deploying learning analytics (Ferguson *et al.*, 2014). In this paper, we present three case studies that adapted the LISSA dashboard for academic advising to the needs of Latin American institutions. The case studies shed light on how an existing dashboard can be reshaped to address the contextual needs of different institutions.

Methods

The work is twofold: to analyse adaptations performed and the relations to the different cases' contexts (RQ1), we use the framework COALA. To evaluate the support provided by the adapted dashboards (RQ2), we perform pilots following the directions of the LALA project.

The COALA framework

The Context Adaptation for Learning Analytics (COALA) framework constitutes four contextual dimensions for the adaptation of tools:

- *Objectives* of using the dashboard, eg, "to identify subjects where a student has low or high performance".
- *Stakeholders* that are involved in using directly or indirectly the dashboard, such as advisors, teachers, students, administrative staff.
- *Key moments* in which the use takes place, such as at the beginning of the academic term when registering courses, or when students receive grades.
- *Interactions* between stakeholders, such as advisor-students face-to-face sessions.

These perspectives allow to systematise, organise and cross reference the information revealing the importance of the context. COALA was first presented, although without this name, in the work of Millecamp, Broos, De Laet, and Verbert (2019). It borrows *Objectives* and *Stakeholders* of the learning analytics framework of Drachsler and Greller (2012) and adds *key Moments* and *Interactions* after an experience in an Ecuadorian university in which teachers were asked to identify the context for a learning analytics dashboard tool (Millecamp *et al.*, 2019).

Fifth section "Dashboards" presents details of the application of COALA and the adapted dashboards.

LALA Project and pilots

The cases in this work are coordinated by the LALA Project (Maldonado-Mahauad *et al.*, 2018) with support of European partner institutions. The project deployed diagnostic activities to determine learning analytics niches and opportunities within the context of LATAM partner institutions (Sanagustín *et al.*, 2019). Three partners focus on support of the advising process

with a dashboard using academic records. These are University of Cuenca, Ecuador (Cuenca), Universidad Austral de Chile (UACh) and Escuela Superior Politécnica del Litoral, Ecuador (ESPOL). Tools were developed and further piloted adapting ideas from LISSA (Charleer *et al.*, 2018), a baseline dashboard tool provided by one of the European partners. The work on the three cases was not performed in isolation, but in collaboration through several meetings and coordinated activities.

To evaluate the dashboards, each institution conducted pilots with real users. Pilots were organised in the following phases:

- *Preparation*: Involves coordination of the different institutions through the LALA project to define dates, target participants, evaluation methods and instruments (eg, surveys).
- *Agreement*: Performs participant recruitment, collects consent forms and users' perceptions on advising work that would serve as a baseline. UACh applies a Likert scale survey with questions about perception on the amount of work involved in special course registration requests and the perception of the current support received from the university. Cuenca uses a similar survey with small adaptations. Since ESPOL's pilot targeted the whole institution, the baseline questionnaire includes only one question: "The information (eg, tables, graphs) currently provided by the counselling system is sufficient to make sound decisions to guide the student", plus open text comments to collect details.
- *Training*: The dashboard is introduced and participants are trained. Participants are exposed to real data of students of their schools. Short evaluations are performed to ensure the success of the training. ESPOL applies at this moment the System Usability Scale (SUS).
- *Use*: Participants use the dashboard during the academic year (2019), and log data are collected. At ESPOL and Cuenca, advisors were told to inspect student situations and make appointments with students they consider necessary to meet. Cuenca also surveys students who attended advising sessions on their perception of the support while using the dashboard with the advisor. At UACh, advisors use the dashboard to inspect academic situations and decide on special course registration requests. An extra session one month after training is performed at UACh to collect feedback on utility and impact of the dashboard.
- *Improvement* (or closing) to finalise the pilot, post-questionnaires evaluate the perception of participants of the general support gained with the dashboard. ESPOL applies the one question survey mentioned above in the *Agreement* phase. UACh and Cuenca apply a more extended survey (Likert scale) that includes items about decision support, efficiency, effectiveness and reflection about the work and the academic situation of students.

All cases performed sessions in groups with participants to stimulate conversation and interchange of information. While the overall methodology is similar, it is important to note that the different context of the pilots demanded that different surveys were used. Surveys are presented with results in sixth section.

Cases

Case A: University of Cuenca

Universidad de Cuenca is a public institution located in Ecuador. Initial elicitation of learning analytics needs highlighted the importance of initiate advising processes, but also identified resistance due to the additional workload required and the lack of policies allowing to assign work hours to it.

Academic information includes academic records (courses passed, failed and dropped, grades) and study programme structures (careers) with prerequisite relations between courses. Students

register courses using an online application and often meet career directors when not meeting all course requirements. To support advising, the LALA team proposed to deploy systematic advising involving teachers assigned to students. Advising sessions take place during midterm and before the beginning of the term to advise students about the future path. There were no learning analytics initiatives implemented, and career directors have to consult different academic reports to inspect academic situation of students.

Case B: Austral University of Chile (UACh)
At UACh, as in most of Chilean universities, curricular plans have a fixed structure in which the study sequence is predefined with a strong course prerequisite structure. Higher fail rates delay students in their academic plan early on and high cost of study pushes students to try to catch up as much as possible, resulting in a considerable number of special requests for registering courses for which students do not have all prerequisites. Starting each term, programme directors have to decide on hundreds of special course registration requests, which require to inspect academic situation taken as snippets of information from different parts of the current system. Thus, programme directors perform advising tasks in many cases. A dashboard for academic information could support their work.

Case C: ESPOL
Since 2013, ESPOL in Ecuador has implemented systematic advising to help students detecting their strengths and needs. Teachers are assigned students based on their current administrative workload (the less the workload, the more the advising work assigned, on average 20). The advising sessions are held twice every semester: Before student registration, and mandatory during midterm for students with low achievement (GPA below 7) or retaking a subject. Freshmen do not attend advising sessions because courses are automatically registered. Advising meetings can last 15 minutes or more. Students have to fill out a survey assessing the advising session afterwards, and it is a condition to enable course registration for the upcoming semester. The advising process is explained to new teachers and students before entering ESPOL.

An information system supports the advising tasks and shows different panels about personal data (eg, name, ID number) and academic data (eg, academic history, progress, credits passed, etc). The term-by-term information is shown on different pages; thus, if a teacher wanted to look for older records, he/she should click on "next", losing the view of the previous page. In this context, LALA proposed to enhance the current system adding learning analytic visualisations.

Dashboards

LISSA dashboard
LISSA (Figure 1) is a dashboard at KULeuven supporting the advisor–student dialogue by empowering advisors with visualisations of student's career path (Charleer *et al.*, 2018; Millecamp *et al.*, 2018). Advisors are responsible for the study advice and content-related support for first-year students. They are experts in both the content of the first-year courses, the organisation of the programme and the programme-specific and university-wide regulations.

LISSA provides an overview of first-year key moments in chronological order: The grades of the positioning test (entry diagnostic exam), mid-term tests, January exams and June exams. A general trend of performance at the top shows the position of the student among their peers. Every course taken is tiled, showing name and obtained grade (out of 20). A green, orange and red colour coding represents successful exams, tolerable grades (students can request to pass a

Figure 1: LISSA dashboard for academic advising [Colour figure can be viewed at wileyonlinelibrary.com]

Table 1: Objectives of dashboards, adaptations and context (part 1)

Objective	*Context and features in LISSA*	*Context at LATAM*	*Adaptation in dashboard*	*A Cuenca*	*B UACh*	*C ESPOL*
Grasp the current academic progress of a given student	Progress is understood as credits passed in the first-year exams which are colour coded to reflect performance	A, B, C: Progress is understood as the courses passed with respect to the whole curricular structure of the programme	Overlaid academic history on top of the curricular structure	X	X	
			Separate curricular structure and visualisation of academic history term by term			X
Identify courses passed, failed, dropped, delayed, and repeated	Credits obtained determine if each exam is passed or failed with a range of uncertainty in between (orange zone)	A, B, C: Final grades of courses determine if students passed or failed	Passed and failed courses are colour coded, no "orange zone"	X	X	X
		A, B, C: Dropped, delayed and repeated courses help understand academic history	Each course is shown once (overlaid layout) and repetitions are marked with extra visual features	X	X	
			Courses are shown each time taken (academic history)			X
			Associate courses to areas (general, speciality, etc)	X		X
			Overlaid layout allows to easily identify delayed courses	X	X	
			Dropped courses are explicitly marked	X	X	
Grasp evolution through terms of the academic life	Summary of performance by exam date is plotted to be able to identify trends on performance during the first year	A, B, C: Summarised display of term by term information needs to combine performance and course load	Show term by term plot of GPA	X	X	X
			Show term by term course load	X		X
			Linking term by term plots with overlaid layout	X	X	

Table 2: Objectives of dashboards, adaptations and context (part 2)

Objective	*Context and features in LISSA*	*Context at LATAM*	*Adaptation in dashboard*	*A Cuenca*	*B UACh*	*C ESPOL*
Identify prerequisites met for a given course	Prerequisite relationships between exam subjects exist, but for the first year this information is not critical in the dashboard	A, B, C: Prerequisite relations constraint courses to take	Prerequisite relations shown backward and forward in the curricular structure	X	X	X
		A, B: Prerequisite relations on a 10 semester (more than 50 courses) programme may clutter	Show prerequisite relations only on demand (for a given course)	X	X	
Compare student performance to peers	Comparing student's performance to group motivates reflection and it is valuable for advising. It is sensible information, thus the advisor decides if showing the histograms of grades in advising sessions	A, B, C: Comparisons are needed at different scopes (same cohort, same term, same parallel group)	Comparing grade distributions on the same class (same term and same parallel group)	X		X
		A, B, C: Comparisons in term by term summary and at course level	Comparing grade distributions on the same term		X	X
			Comparing historic grade distribution		X	
		A, B: Concerns exist in showing comparison information	Comparison features at course level are shown on demand	X	X	
			Comparison features of term by term performance shown on demand	X		
			Term by term summary compared to programme averages		X	X
			Term by term summary compared to same cohort averages			X
			Term by term summary compared to same class averages	X		

Table 3: Objectives of dashboards, adaptations and context (part 3)

Objective	*Context and features in LISSA*	*Context at LATAM*	*Adaptation in dashboard*	*A Cuenca*	*B UACh*	*C ESPOL*
Plan course registration for the next term	Exams plan is a common task in advising sessions where implications on academic load and risk of failing is judged given the performance in the past and historic information	A, C: Course planning is a central task in advising sessions and needs information of course load and difficulty	Display accumulated load on planned courses distinguishing theoretical, practical and autonomous hours	X		X
		C: Course planning module already existed lacking display of course load; advisors need to assess their past planning recommendations	On available courses display past performance indicators and associated load	X		
		B: Not implemented because of focus on special requests rather than face-to-face advising	Planned courses can be compared with previous term loads taken by the student	X		X
			Recommend courses for which prerequisites are met	X		X
			Allow advisors to see past planned and taken courses			X

Table 4: Stakeholders of dashboards, adaptations and context

Stakeholder	*Context and features in LISSA*	*Context at LATAM*	*Adaptation in dashboard*	*A Cuenca*	*B UACh*	*C ESPOL*
Advisors	Advisors are professionals with training in academic advising whose main task is to perform advising sessions	A, C: Advisors are teachers assigned to a number of students according to their current work load	Advisor role can access certain assigned students			X
		B: Advisors are programme directors, each can serve hundreds of students	Advisor user can access all students in a specific programme	X	X	
		C: Special access is given to super users or welfare department who need to inspect academic information on special cases	Special roles enabled to access all students in the institution	X	X	X
Students	It is important to deploy advising platform for the first-year students given that access to the university does not have selection process at KU Leuven. Students do not access the dashboard by themselves.	A, B, C: Advising tasks are supporting all year students in programmes that last for 4 or 5 years and that have different schemas and characteristics (specialisations, internships, different grading schemas, etc)	Support for specialisation curricular branches and optative courses	X	X	X
		A, C: Not used by students alone	Support for different grade schemas		X	
		B: Student access is possible and recommended by advisors	Support for programmes that combine annual, semestral and/or summer courses		X	X
			Comparison features can be hidden when students are present	X		
			Student user can access to her own data		X	
			Add information of extracurricular activities			X

Table 5: Key moments of dashboards, adaptations and context

Key moment	*Context and features in LISSA*	*Context at LATAM*	*Adaptation in dashboard*	*A Cuenca*	*B UACh*	*C ESPOL*
At course registration period	only limited advising is done at the beginning of the first year	A, C: Advising sessions occur at the beginning of the term to helps students plan courses to take B: Advisors decide on special course registration requests	Special module to recommend courses for the next term	X		X
Within the semester	Advising sessions occur after evaluations, when students receive grades	A, C: Midterm advising sessions are supported by showing partial grades	Show partial grades (midterms)	X		X
		B: Advisors decide on course dropping requests; advisors meet students anecdotally on their request and may use the dashboard	Show current term registered courses	X	X	X
			Allow advisors to report to welfare department			X
			Display student welfare information			X

Table 6: Interactions of dashboards, adaptations and context

Interactions	*Context and features in LISSA*	*Context at LATAM*	*Adaptation in dashboard*	*A Cuenca*	*B UACh*	*C ESPOL*
Face-to-face student–advisor	LISSA is used exclusively for face-to-face student–advisor sessions and privacy policies requires explicit authorisation from the student.	A, B, C: No special feature is needed to ensure authorisation for accessing academic information other than authentication and role. A, C: Face-to-face sessions are systematised as short meetings which stress the need to present relevant information condensed; some advising sessions has the goal of planning next term courses C: Advisors only have access to the system during face-to-face sessions	Support schedule and notification for advising sessions			X
			Allow advisors to record general observations	X		X
			Module to plan next term courses	X		X
			Display past advising sessions information			X
			System open and closes on specific time (only for sessions)			X
Advisors alone	Advisors can access the system for students he/she is advising	A, B: Advisors can access academic information at any time. B: Advisors decide on special course registration and dropping requests	Allow advisors to record general observations	X		
			System can be used at any time by the advisor	X	X	

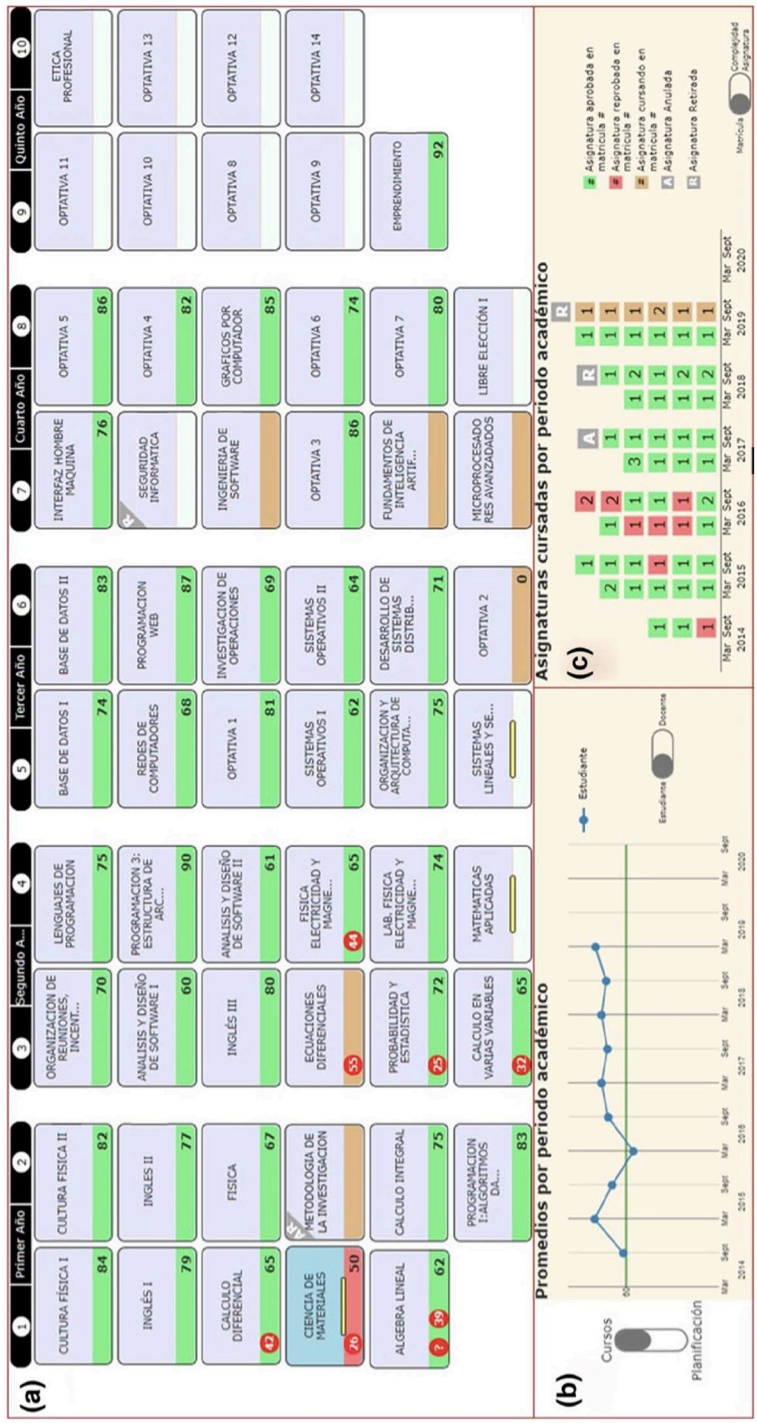

Figure 2: Academic advising dashboard in Cuenca [Colour figure can be viewed at wileyonlinelibrary.com]

limited number of 8–9/20 grades) and failed courses. Clicking on a tile displays a histogram of performance of peers and the position of the student among them.

Unit charts provide historical data of students for three student profiles (defined based on the number of obtained credits) with their time-to-graduation distribution shown when hovering the chart.

Other modules depend on the time of advising. One module supports the planning of re-sits in summer by allowing to select courses and representing (visually) the percentage of students that passes the same number of re-sits in the past.

LISSA was deployed in 26 programmes at KU Leuven, hereby supporting more than 110 academic advisors. LISSA is currently being integrated in the university, and hereby expected to be scaled up in the academic year 2020–21.

Dashboard adaptations and contexts

A summary of adaptations framed by the COALA framework is presented in Tables 1–6. The first columns list common *objectives*, *stakeholders*, *key moments* and *interactions* of the dashboards. Differences and similarities with the baseline dashboard LISSA and between the cases are in the second and third columns respectively. From these tables, important issues are revealed and bullet-pointed here.

- The three cases agreed on combining curricular structure information and academic records to *see* student's progress in long career programmes (5 years, more than 50 courses). While Cuenca and UACh opted to present this information together in an overlaid layout, ESPOL added a visualisation of the academic history similar to LISSA. The overlaid layout is a major change with respect to LISSA and breaks the original layout in two: The term-by-term structure, and the term-by-term student history.
- All cases include features that compare a student with peers. While in LISSA this comparison is to the same cohort peers (because it serves first-year students only), in LATAM cases comparisons range from classmates to all students in the same term, all students in the same programme, all historic data, etc.
- Advising approaches are very different when we look at the interactions and key moments: Face to face (LISSA, ESPOL, Cuenca) or not (UACh), to plan the next term (Cuenca, ESPOL), or to reflect about performance at exams (LISSA) or midterms (Cuenca, ESPOL), or for advisors to make decisions (UACh). Since Cuenca and ESPOL use the dashboard for face-to-face student–advisor sessions at the time of course registration, the tool needs to provide features to plan the next term with supporting information about aggregated workload and difficulty.

Case A: Advising dashboard at Cuenca

AvAc ("Avance Académico"), inspired by the other cases and the baseline dashboard LISSA, was built by applying a user-centred design through interviews and focus groups (Figure 2). The main window is divided into three linked visualisations summarising study progress and performance. Curricular structure visualisation (see Figure 2a) shows courses and the corresponding grades. Colours and other visual elements represent academic records (courses passed, failed, repeated, dropped, cancelled, delayed and registered). By clicking on a course, *prerequisites* and *post-requisites* are highlighted, and details of the course clicked are displayed. Historic performance visualisation (see Figure 2b) shows the term-by-term plot of student's average performance and, on demand, comparison with the performance of students in the same class. A historic course workload visualisation (see Figure 2c) shows term-by-term course load, the performance on

Figure 3: TrAC dashboard. The segmented border box in the bottom right is added to show when a course is clicked [Colour figure can be viewed at wileyonlinelibrary.com]

Figure 4: Academic history visualisation in ESPOL dashboard [Colour figure can be viewed at wileyonlinelibrary.com]

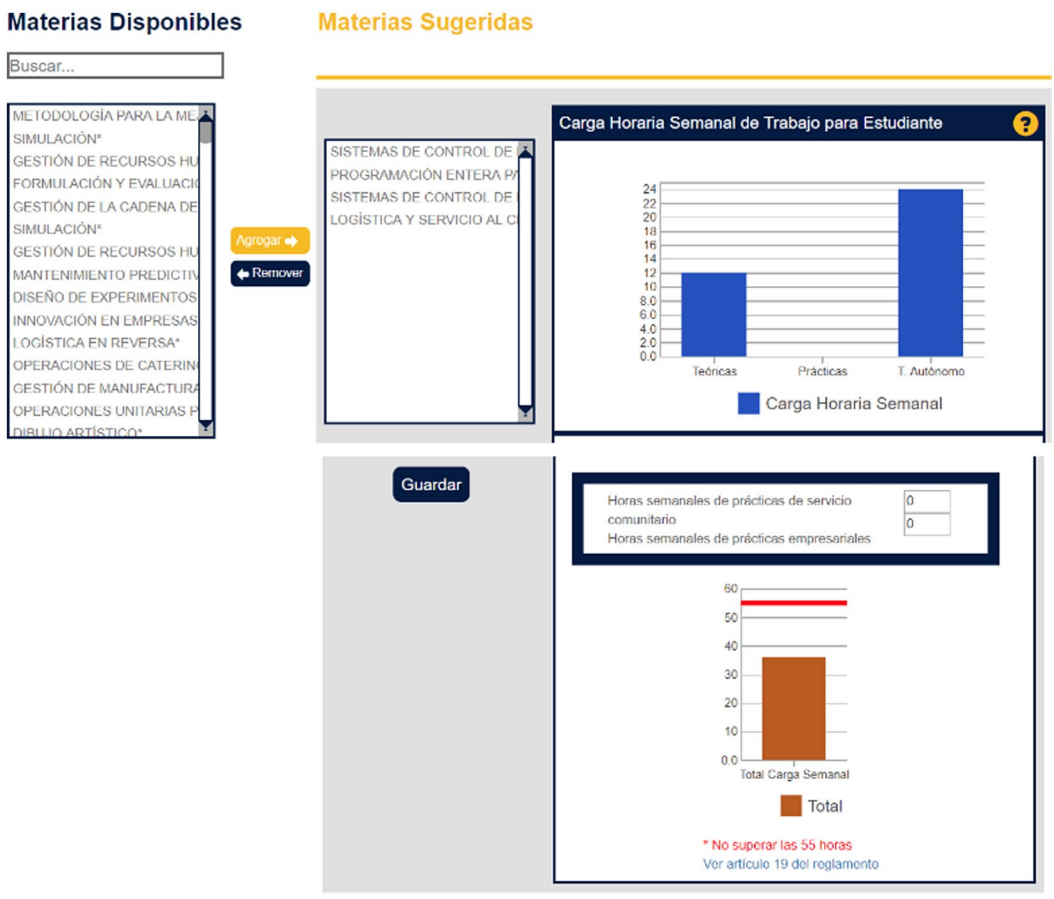

Figure 5: Course planning module with visualisations of course load in ESPOL dashboard. Courses available (Materias Disponibles) can be added to the plan (Materias Sugeridas) [Colour figure can be viewed at wileyonlinelibrary.com]

these courses (pass/failed/dropped) and course difficulty which are represented by aggregated academic records of the course (fail rates) and the number repetitions.

Case B: Advising dashboard at UACh

Case B (UACh) developed TrAC (from spanish "Trayectoria Académica y Curricular") shown in Figure 3. Details of the participatory development of TrAC and its functionalities are described in Chevreux, Henríquez, Guerra, and Scheihing (2019) and Guerra, Scheihing, Henríquez, Olivares-Rodríguez, and Chevreux (2019). Similar to Cuenca's dashboard, TrAC overlays academic records on top of the curricular structure, as this is the "natural" form in which academic progress is understood at the institution. Clicking a course shows details and two histograms of grades (1.0–7.0, passing grade is 4.0), one for all past academic records and another only considering classmates. Clicking a course also highlights pre- and post-requisites of the course (see the segmented box). The chart at the top of Figure 3 displays the student term-by-term averages performance. By clicking on the buttons on the x-axis (which are the student's terms), courses taken that term are highlighted in the main area with their corresponding status (grade, pass,

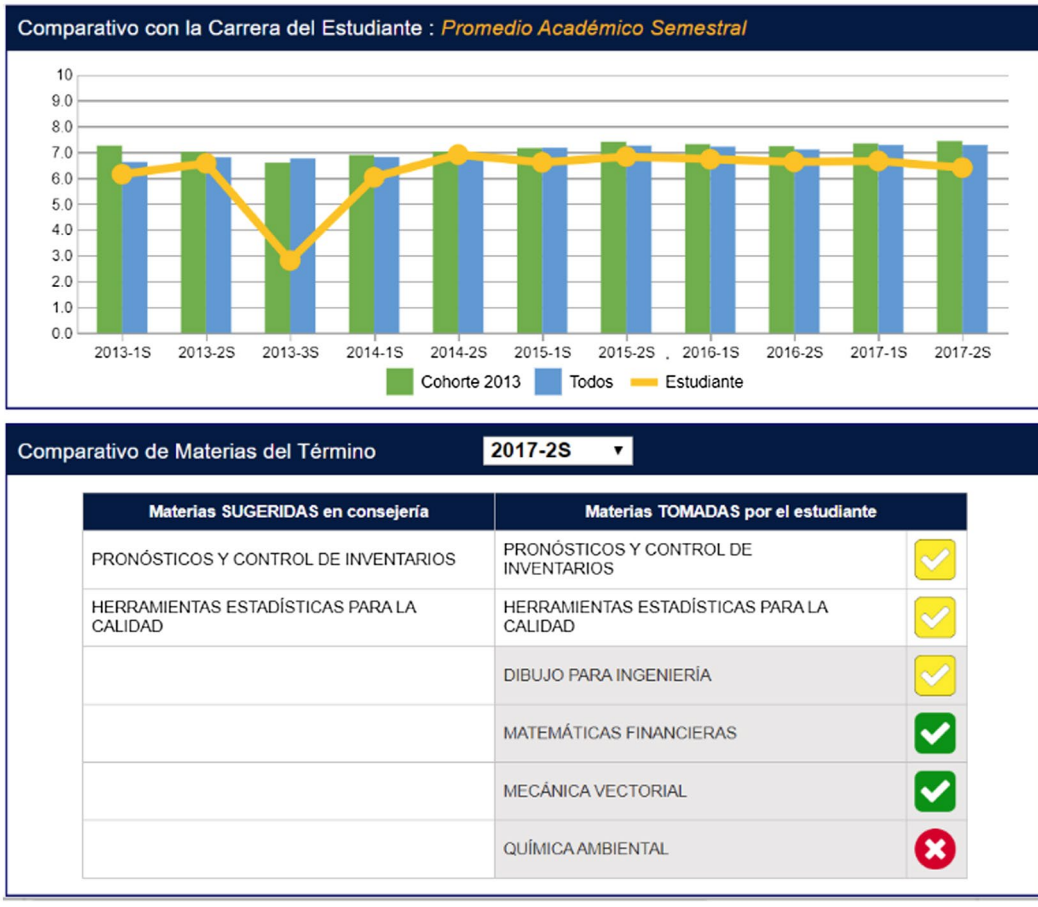

Figure 6: Term-by-term academic summary, ESPOL dashboard. "Comparativo con la Carrera del Estudiante" compares student performance to all students and cohort. "Comparativo de Materias del Término" shows list of suggested and taken courses and the status of these courses (passed, failed)
[Colour figure can be viewed at wileyonlinelibrary.com]

failed, dropped) on that term. In this way, advisors can navigate the student academic history "back in time".

Case C: New visualisations for dashboard at ESPOL

At ESPOL, the existing information system used in advising was improved with three visualisations. Figure 4 shows a term-by-term layout arranged similar to the baseline dashboard LISSA, showing courses taken each term with status pass/failed (check mark or cross on top right corner), number of times taken (colour on check marks) and who the teacher was. Clicking a course displays details of average grades and comparison to peers. Courses' background colour represents types of courses (foundational courses, professional courses, complementary courses, etc).

A second visualisation complemented the course planning module (Figure 5) displaying weekly workload (hours) and difficulty of the courses added to the plan. This provides enough data to advisors to make sound decisions instead of relying only on their previous experience.

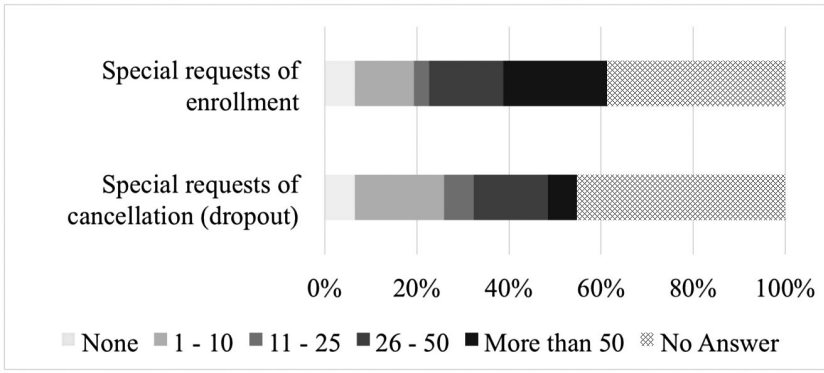

Figure 7: Number of special requests by term (Cuenca, Agreement phase)

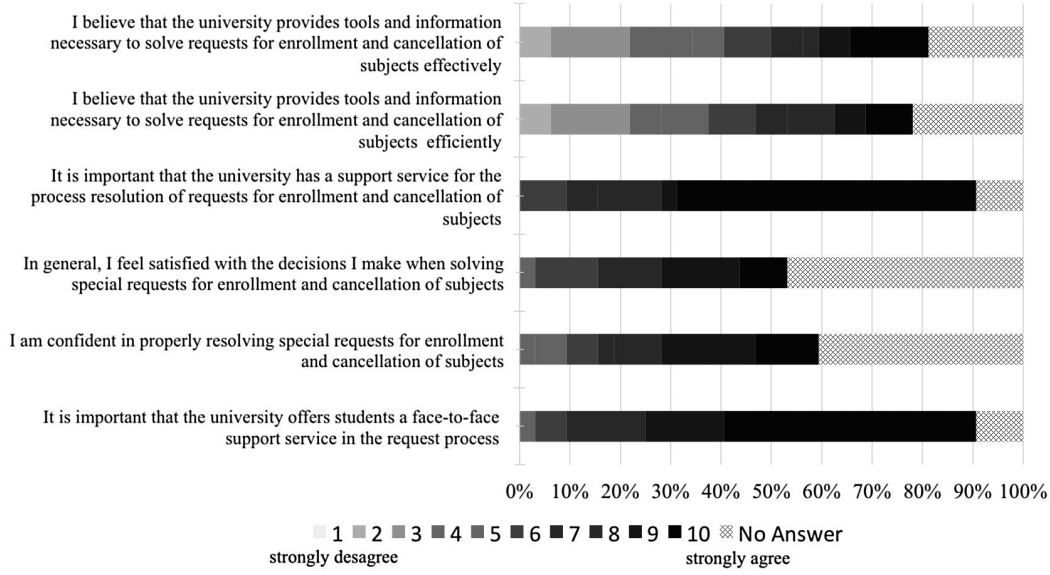

Figure 8: Perception about special requests process (Cuenca, Agreement phase). Cancellation refers to drop subjects (courses)

The third component adds a new window to inspect the academic history of the student, term by term, and includes performance summary and comparison to peers, summary of courses taken versus courses suggested by advisors, and information provided from advisor to the Welfare Department (Figure 6).

Pilots and results

Case A: Cuenca

Cuenca faces the challenge of adopting both a tool and a process with no academic advising experience available. Therefore, the pilot started with selecting enthusiastic teachers. The *Agreement* phase recruited 75 teachers and staff of eleven programmes belonging to Engineering, Economic

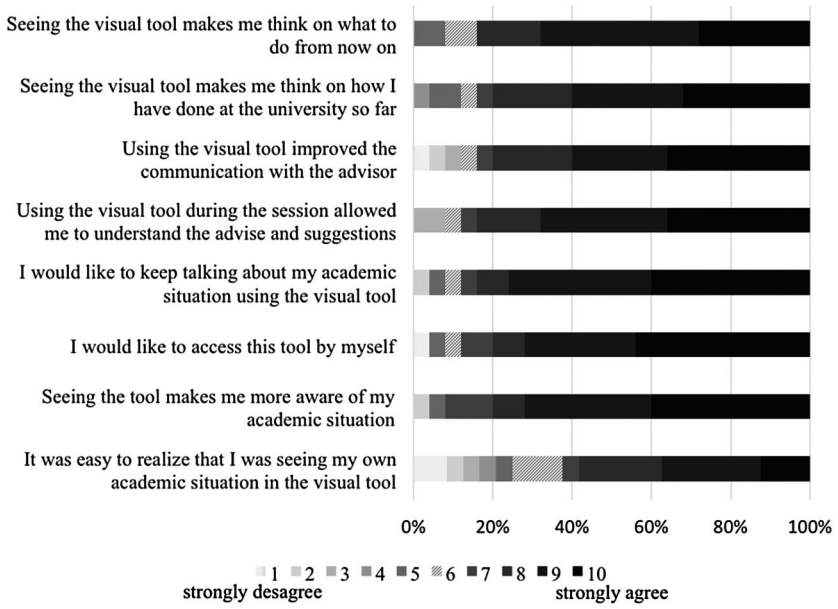

Figure 9: Students' perceptions about the dashboard (Cuenca, Use phase)

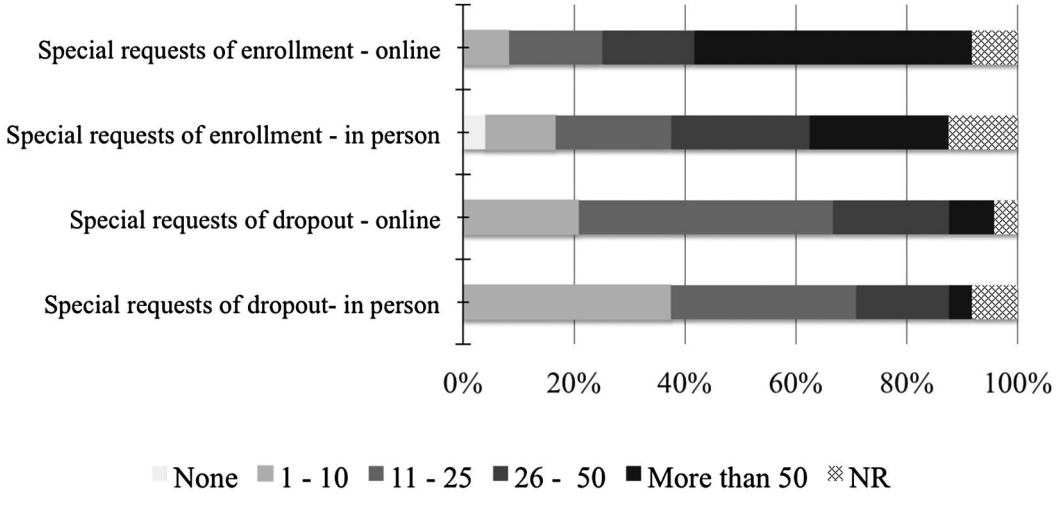

Figure 10: Number of special requests by term (UACh, Agreement phase)

and Administrative Sciences, Chemical Sciences, and Hospitality schools (close to 50% of the university schools).

Training was implemented in four sessions and results of the baseline survey are summarised in Figures 7 and 8 and revealed that it is important that the university offers students a face-to-face support service during the request process, and improves the support for enrolment and cancellation requests. The number of special course registration requests is 50 or more per school and

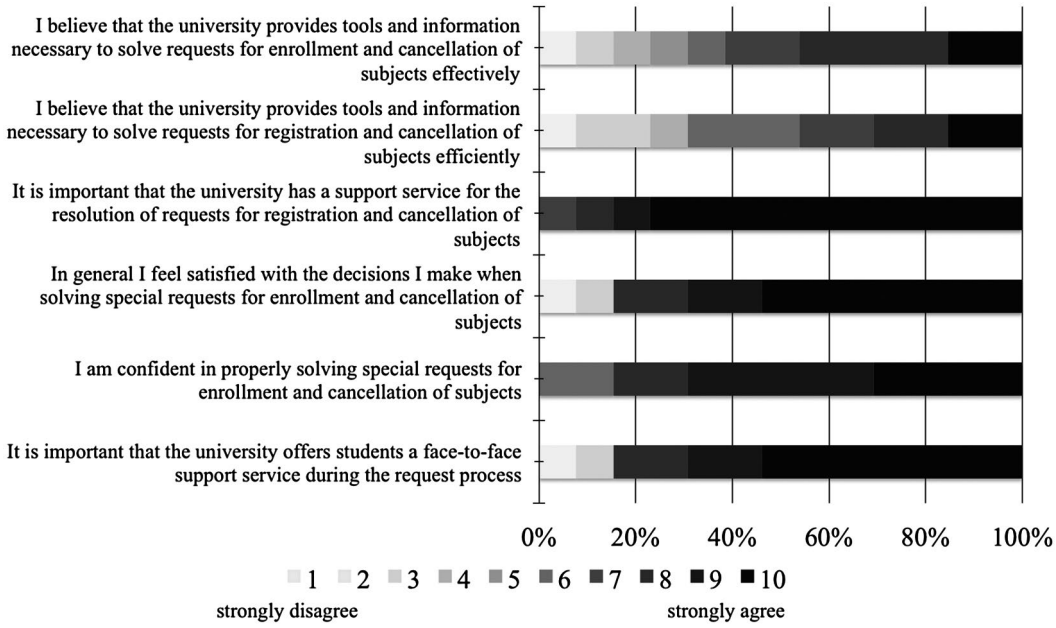

Figure 11: Perception about special requests process (UACh, Agreement phase)

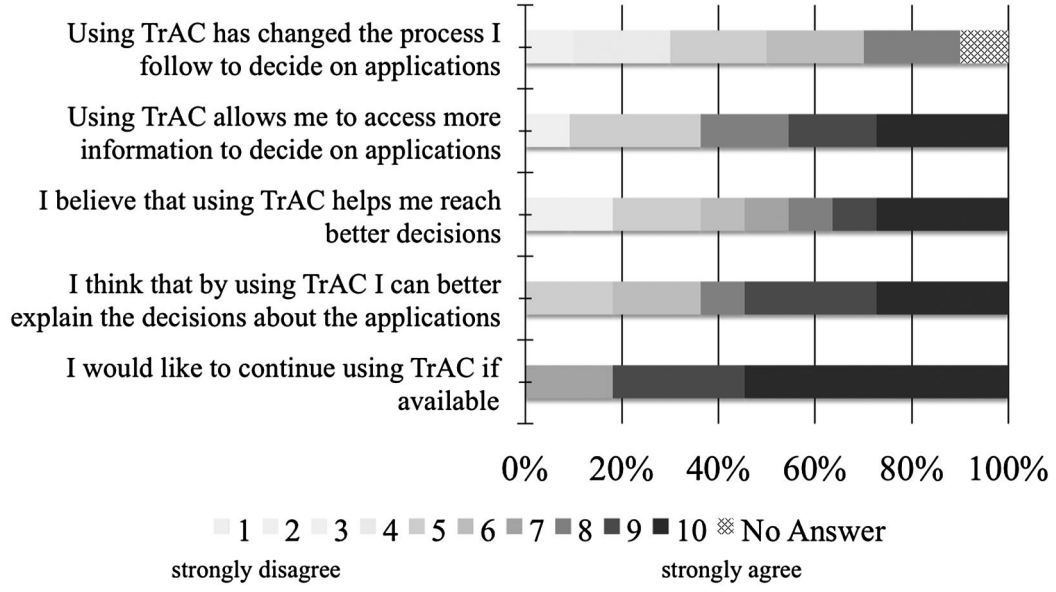

Figure 12: Perceived usefulness of TrAC (UACh)

each request takes between 2 and 5 minutes (Figure 7). Participants agree on displaying the academic information as a dashboard, which will be much better than navigating different reports. However, some participants were worried about having extra workload because of the need to adopt both a tool and an advising process.

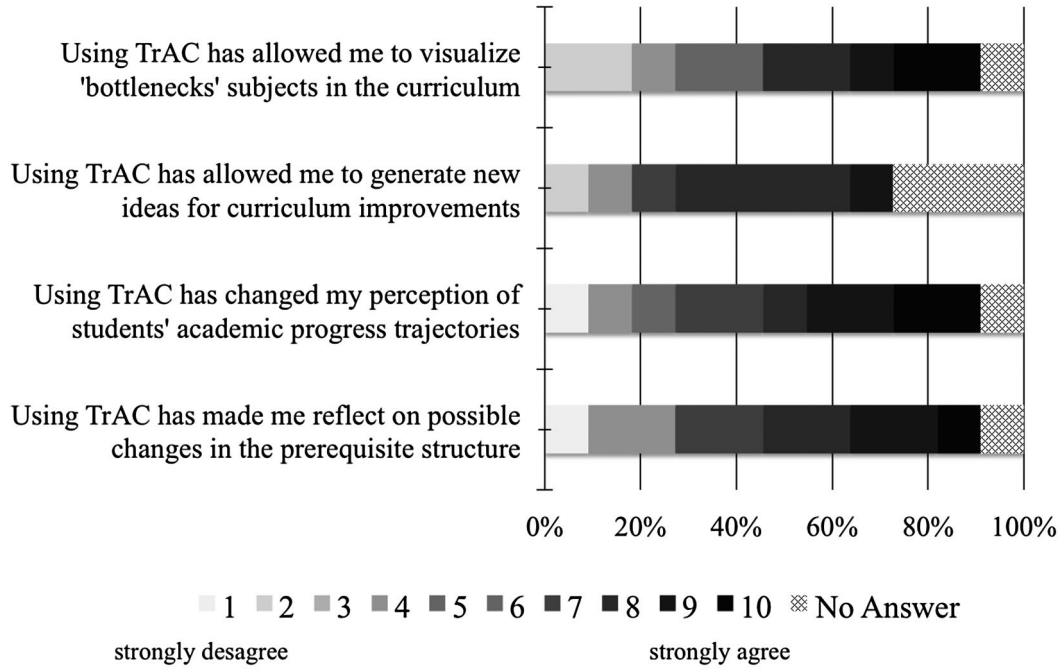

Figure 13: Perceived potential impact of TrAC (UACh, Use phase)

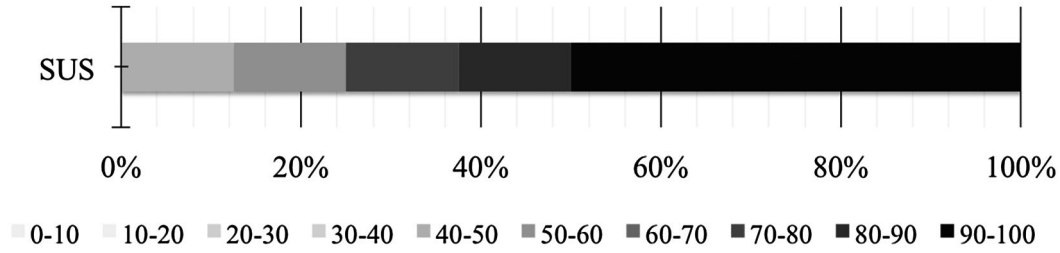

Figure 14: Distribution of SUS score for TrAC (UACh, Improvement phase)

Four additional training sessions, one per school, took place after introducing some improvements (eg, show cancellation of subjects per term, allow to analyse historic programme structures). At this time, deans assigned programme heads and members of the Academic Committee of the programmes as advisors.

The *Use* phase had (at the moment of writing this paper, Cuenca has not closed the pilot) 31 advisors actively using the tool. Log data reveal that 522 students have been inspected and 178 attended advising session by invitation, plus 6 attending in their own interest. Only 25 of them answered the survey and results are shown in Figure 9 and are, in general, positive. Students think the dashboard improves the advising session, and made them think more about their academic situation. However, it seems that it is not that easy for students to recognise their own academic situation, which is not critical due to the fact that dashboard is accessed in advising sessions with an advisor present.

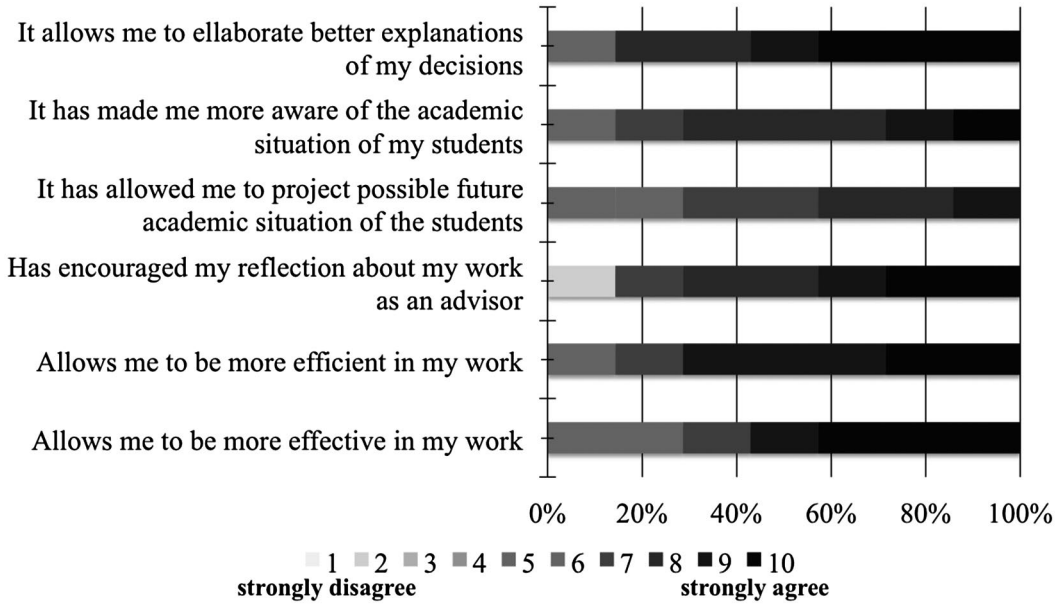

Figure 15: Survey on impact and utility of the dashboard (UACh, Improvement phase)

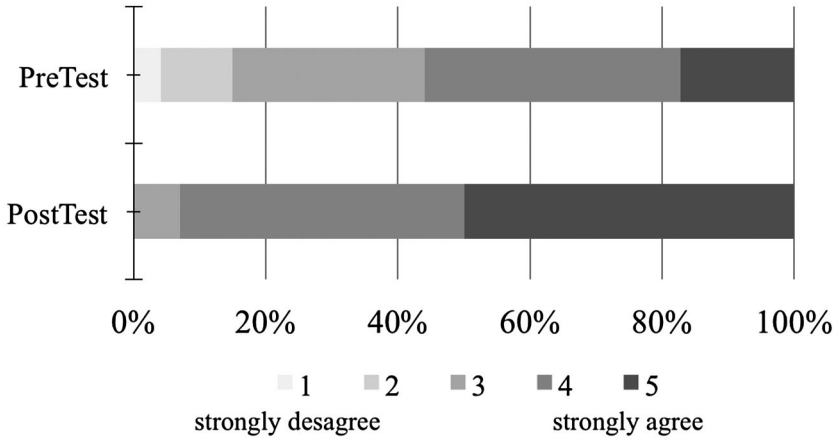

Figure 16: Responses to the questionnaire before (pre) and after (post) introducing the new visualisations (ESPOL, Agreement and Improvement phases)

Case B: UACh

TrAC's pilot started early 2019 with 14 programme directors from different programmes and three different campuses, covering around 20% of all programmes offered at UACh. Not all advisors participated in all sessions. Results of *Agreement* phase surveys are summarised in Figures 10 and 11. Results reveal that the number of special course registration requests to be solved is considerable (from 50 to 300) and takes considerable time (each request more than 5 minutes). Discussion and comments during the *Agreement* session revealed that directors welcomed the idea

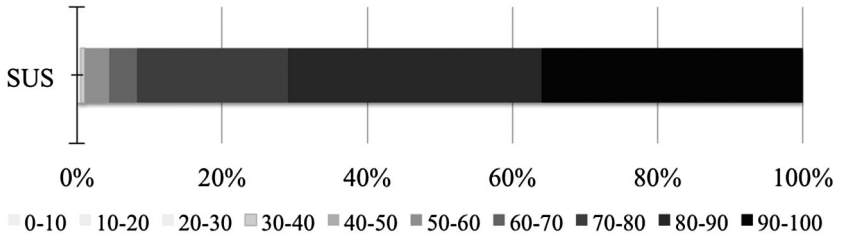

Figure 17: Distribution of SUS score for counselling tool (ESPOL)

Table 7: Logs of use of Visualisations (ESPOL, Use phase)

Term		*Number of teachers*	*Number of students*	*Percent of students (%)*
First semester 2019	Stakeholder involved in counselling	317	7714	
	Using three visualisations	177	1035	13.41
	Using two visualisations	250	2221	28.53
	Using one visualisation	287	3655	47.38
	Using none	12	823	10.66
Second semester 2019	Stakeholder involved in counselling	322	4850	
	Using three visualisations	91	227	4.68
	Using two visualisations	132	416	8.57
	Using one visualisation	151	532	10.86
	Using none	61	3675	75.77

of a tool that could make this process easier. They stressed the issue of having to access information from different parts of the current system which translates in time, confusion and potential mistakes while deciding.

The *Training* phase had to be delayed to the last days of the period in which the advisors decide on special course registration, thus some participants already had that work finished or were well advanced.

During the *Use* phase, 11 participants provided feedback on usefulness and impact. In this session, some improvements on the dashboard were also introduced (eg, show currently registered courses). Results, reported in Figures 12 and 13, show that TrAC allows them to make better decisions, to better explain these decisions and potentially reduce errors. They would like to keep using the tool. Interestingly, the survey also revealed that TrAC has not necessarily changed the process they follow to solve the requests nor provided new or more information. The group discussion identified reasons: TrAC provides the same information already available, but joined in an easy-to-use display, avoiding the need to go back and forth between parts of the current system and saving time. However, advisors still have to use the current system to submit request decisions. Additionally, directors agreed that TrAC is very useful, even though the tool was released just before the period to solve requests ended. Directors reported using the tool to verify requests and inspect some student cases. At least two participants quickly spotted problems in the (pre-) requisite structure not noticed before in the current system, which caused increasing number of special requests.

Also in the *Use* phase, log data collected by the system show different levels of usage. All users inspected a total of 141 student situations (avg 8.8), and performed more than 2000 actions (avg

137.6). Nine users performed more than 100 actions (max 481). We think that these data are encouraging considering that the pilot started late in the academic term.

Eight users participated in the *Improvement* phase. The System Usability Scale (SUS) results averaged 76.9, which is considered good. The distribution of the score is shown in Figure 14. Results on the impact and utility of the dashboard are shown in Figure 15. Results showed positive evaluation of the dashboard especially in making the work more efficient and effective, and providing means for explaining decisions better.

Case C: ESPOL

At ESPOL, the new visualisations and information displayed were piloted in regular advising sessions at the whole institution during 2 semesters in 2019. Out of 341 advisors at ESPOL, 187 were engaged (*Agreement* phase) and attended the training sessions, and 117 answered the pre/post-questionnaire (*Agreement* and *Improvement* phases) containing one question: "The information (eg, tables, graphs) currently provided by the counselling system is sufficient to make sound decisions to guide the student." The responses are distributed as shown in Figure 16. Higher rates of higher agreement in the post-questionnaire are clear evidence of the utility of the new visualisations.

Free-text comments complemented assessment referring to the complexity of the data "*It is difficult to interpret and relate to the data presented by the student and the information available in the platform*"; to the current display features "*table are not so friendly. You cannot quickly observe subjects approved in previous years and grades, but you have to enter another section of the system*"; to the availability of information "*there is a lot of information that should be accessible from the same counseling* [advising] *page, and that is important information for the student (study and food scholarships, exchanges, financial aids) and that many time we don't have at hand.*"

Similar comments collected in the *Improvement* phase (post-questionnaire) revealed positive perception of the new features:

"The information to advise students is clearer and more accessible, which allows you to see in a faster and easier way what has happened during the student's career, to know what is the possibility that he or she will lose the race and give a more adjusted way to the student reality recommendations"; "The new features are very useful to properly guide the student"; "I think that the information that the system now shows is important. It allows to know more aspects about the student performance. It allows you to know your academic history in more details."

During the *Training* phase, 183 advisors answered the modified SUS (System Usability Scale) questionnaire. Since the questionnaire was modified, we report here the distribution of the overall score (Figure 17).

Log data of the *Use* phase, captured during the two semesters in 2019, are summarised in Table 7.

Discussion

RQ1: "*How does the context of Latin American HEIs influence the adaptation of an advising dashboard designed in a European University?*" is addressed by presenting the experience of three cases of Latin American Universities, contrasting between them and the original LISSA dashboard. The COALA framework helped us reflect on how our contexts, our needs, influence the technical decisions to design the system. Even when the objectives are the same (eg, "*Grasp the current academic progress of a given student*"), differences aroused when considering stakeholders, key moments and interactions (eg, advising is implemented online, or through face-to-face sessions). Main contextual aspects revealed are as follows:

- In all Latin American (LATAM) cases, the academic information needs explicit display of curricular structure. Academic progress is understood as an overlay of the courses passed on top of the programme structure. This is a clear difference with the context of LISSA. Both Cuenca and UACh opted to incorporate both aspects to the main display of the dashboard, while ESPOL, already having a dashboard running with a view of the curricular structure, opted to follow LISSA's approach.
- There are different levels of systematisation and different approaches regarding advising procedures in the LATAM institutions. ESPOL already having advising processes running opted to complement the existing dashboard with visualisations designed to facilitate academic inspection and further face-to-face advising sessions. Cuenca, starting a new advising procedure, seeks to adopt a similar procedure, targeting advisor–student face-to-face sessions. In both these cases, the dashboard includes a course planning tool, as a means to support face-to-face sessions.
- While LISSA is used to advise first-year students, the adapted dashboards will be used with all students of long study programmes, which demand more information to be displayed including prerequisite structure, and term-by-term student trajectories. More information displayed also allows LATAM dashboards to set different peer-comparison scopes (same cohorts, same term, all past students).

Commonalities and differences open opportunities for research. For example, research could shed light on concerns regarding comparison to peers and give recommendations of how to frame and show comparisons minimising potential negative effects.

We applied the COALA framework *post facto* with the intention of organising and presenting information on the experiences on the 2 years of the LALA project. However, we think that using this framework could bring the attention to relevant aspects that may be hidden when starting adaptation of learning analytic tools, and help institutions to progress along this line even if they do not count on the support and funds of a project such as LALA.

Pilots provided evidence of the perceived positive effects, in terms of satisfaction, utility and potential impact of the dashboard implementations, addressing RQ2: "*How do the adapted dashboards support advising processes in the LATAM institutions?*" Advising tasks, even when not officially implemented, consume a considerable amount of effort as evidence by the baseline collected by UACh and Cuenca, and the dashboards contribute to facilitate these tasks. Again, differences in the prior state of advising procedures shape pilots' and dashboards' contributions. At ESPOL—new features in an existing dashboard—advisors positively evaluate new features in supporting decision making during advisor–student sessions. At UACh—new tool to support special request for course registration and dropout—, users indicated that the dashboard facilitates their work, reduces time and allows them to better support their decisions. The case at Cuenca—new tool and a new advising process—started with academic-advising enthusiastic teachers and only has preliminary results which, similar to that at UACh, are steps forward to implement and systematise advising and scale up adoption. Detailed reports of the pilots, as well as access to demos and source code of the tools, can be found in the LALA project website: https://www.lalaproject.org/deliverables/.

Conclusions

This paper presented adaptation and pilot of advising dashboards in three Latin American universities which diagnosed academic advising as a key need. Adaptations started from LISSA, an academic-advising dashboard from KULeuven, and resulted in different implementations to fit

contextual requirements of the cases, spanning from having neither experience nor tools (U. Cuenca), to already institutionalised and systematic advising procedures (ESPOL).

By using the COALA framework, important differences arose when trying to justify the observed adaptations in the three cases. For example, displaying comparison features respond to different concerns (showing/hiding), and different comparison targets (comparing to class peers, same cohort, all students in the same term, all historic data.)

Pilots, coordinated through the LALA project, provided evidence of the positive effects in terms of satisfaction, usefulness and impact of the dashboards. Pilots were different because of the different level of systematisation of the advising procedures at the Latin American institutions. ESPOL deployed new learning analytics in an already existing tool used in institutionalised advising process. In this context, advisors positively evaluate new features in supporting decision making during advisor–student sessions. UACh deployed a new tool to be used by advisors when deciding on special requests for course registration and dropout. Advisors at UACh indicated that the dashboard facilitates their work, reduces time and allows them to better support their decisions. Cuenca deployed a new tool and a new advising process, and started with academic-advising enthusiastic teachers. Preliminary results allow UACh and Cuenca teams to validate the tool and to generate supporting material to scale up adoption.

There are no general truths in adopting learning analytics because adaptations need to fit the context. However, the three cases represent a broad spectrum of different realities regarding advising processes and tools in Latin America and we expect the information presented here can help other initiatives in advancing towards successful adoption. Combined experience informs us of the importance of starting to deploy learning analytics with existing data (eg, academic records) and in existing processes. Moreover, at the moment of writing this paper, four other Latin American institutions are starting to adapt the dashboards presented in this paper with the support of LALA Project partners.

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Statements on open data, ethics and conflict of interest

Details of the LALA Project can be found in https://www.lalaproject.org/deliverables/.

Permission was obtained from the university authorities and people involved to carry out this research. All analyses were performed on anonymised data from advisors and students. Signed consent was collected from surveyed users.

All authors confirm they do not have any potential conflict of interest in the work reported.

References

Aguilar, S., Lonn, S., & Teasley, S. D. (2014). Perceptions and use of an early warning system during a higher education transition program. In *Proceedings of the Fourth International Conference on Learning Analytics and Knowledge – LAK'14* (pp. 113–117). https://doi.org/10.1145/2567574.2567625.

Charleer, S., Moere, A. V., Klerkx, J., Verbert, K., & De Laet, T. (2018). Learning analytics dashboards to support adviser-student dialogue. *IEEE Transactions on Learning Technologies*, *11*(3), 389–399.

Chevreux, H., Henríquez, V., Guerra, J., & Scheihing, E. (2019). Agile development of learning analytics tools in a rigid environment like a university: Benefits, challenges and strategies. *European Conference on Technology Enhanced Learning*, 705–708.

Dawson, S., Joksimovic, S., Poquet, O., & Siemens, G. (2019). Increasing the impact of learning analytics. In *Proceedings of the 9th International Conference on Learning Analytics & Knowledge* (pp. 446–455).

Drachsler, H., & Greller, W. (2012). The pulse of learning analytics understandings and expectations from the stakeholders. In *Proceedings of the 2nd International Conference on Learning Analytics and Knowledge* (pp. 120–129).

Drake, J. K. (2011). The role of academic advising in student retention and persistence. *About Campus*, *16*(3), 8–12.

Ferguson, R., Clow, D., Macfadyen, L., Essa, A., Dawson, S., & Alexander, S. (2014). Setting learning analytics in context: Overcoming the barriers to large-scale adoption. In *Proceedings of the Fourth International Conference on Learning Analytics and Knowledge* (pp. 251–253).

Fritz, J. (2011). Classroom walls that talk: Using online course activity data of successful students to raise self-awareness of underperforming peers. *The Internet and Higher Education*, *14*(2), 89–97. https://doi.org/10.1016/J.IHEDUC.2010.07.007

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

Gutiérrez, F., Seipp, K., Ochoa, X., Chiluiza, K., Laet, T. D., & Verbert, K. (2018). LADA: A learning analytics dashboard for academic advising. *Computers in Human Behavior*, *107*, 105826. https://doi.org/10.1016/j.chb.2018.12.004

Hilliger, I., Pérez-Sanagustín, M., Ortíz, M., Pesántez, P., Scheihing, E., Tsai, Y.-S., Muñoz-Merino, P. J., & Broos, T. (2019). Assessing institutional needs for learning analytics adoption in Latin American higher education. In *Scalability and Sustainability of Learning Analytics Solutions (SASLAS19)*.

Lonn, S., Krumm, A. E., Waddington, R. J., & Teasley, S. D. (2012). Bridging the gap from knowledge to action: Putting analytics in the hands of academic advisors. In *Proceedings of the 2nd International Conference on Learning Analytics and Knowledge* (pp. 184–187).

Maldonado-Mahauad, J., Hilliger, I., De Laet, T., Millecamp, M., Verbert, K., Ochoa, X., & Pérez-Sanagustín, M. (2018). The LALA project: Building capacity to use learning analytics to improve higher education in Latin America. In *Companion Proceedings of the 8th International Learning Analytics & Knowledge Conference* (pp. 630–637).

Millecamp, M., Broos, T., De Laet, T., & Verbert, K. (2019). DIY: Learning analytics dashboards. In *Companion Proceeding of the 9th International Conference on Learning Analytics & Knowledge (LAK'19)* (pp. 947–954).

Millecamp, M., Gutiérrez, F., Charleer, S., Verbert, K., & De Laet, T. (2018). A qualitative evaluation of a learning dashboard to support advisor-student dialogues. In *Proceedings of the 8th International Conference on Learning Analytics and Knowledge* (pp. 56–60).

Papamitsiou, Z. K., & Economides, A. A. (2014). Learning analytics and educational data mining in practice: A systematic literature review of empirical evidence. *Educational Technology & Society*, *17*(4), 49–64.

Phillips, E. D. (2013). Improving advising using technology and data analytics. *Change: The Magazine of Higher Learning*, *45*(1), 48–55. https://doi.org/10.1080/00091383.2013.749151

Sanagustín, M., Hilliger, I., Maldonado, J., Pérez, R., Ramírez, L., Muñoz-Merino, P., … Alexander, W.-W. (2019). *LALA Framework. LALA Project*. Retrieved from https://www.lalaproject.org/wp-content/uploads/2019/04/LALA_framework_Spanish.pdf

Siemens, G. (2012). Learning analytics: Envisioning a research discipline and a domain of practice. In *Proceedings of the 2nd International Conference on Learning Analytics and Knowledge* (pp. 4–8).

Verbert, K., Govaerts, S., Duval, E., Santos, J. L., Van Assche, F., Parra, G., & Klerkx, J. (2014). Learning dashboards: An overview and future research opportunities. *Personal and Ubiquitous Computing*, *18*(6), 1499–1514.