Recipes for institutional adoption of a teacher-driven learning analytics tool: Case studies from three Australian universities

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The changing landscape of higher education is putting increasing strain on educators, leading to a diminishing ability to provide pedagogical and pastoral support to ballooning and diversifying cohorts. Learning analytics promises solutions to these challenges for educators, including by personalising learning support and experiences, streamlining data capture and analyses, and providing teachers with new, efficient teaching approaches. However, reports of these impacts, or widespread adoption of learning analytics, or even examples of cross-institutional collaboration are sparse. We argue that this may be because of a lack of educator-driven learning analytics tools that meet their felt needs, and present case studies from three Australian universities that have collaborated to implement such a tool. This tool, the Student Relationship Engagement System (SRES), empowers educators to collect, collate, analyse, and use student engagement and success data that they consider meaningful for their particular contexts. Developed by unfunded educators and widely adopted through collegiate recommendations, the SRES enables personalisation and targeting of student learning and support using relevant data, fostering positive student-teacher relationships and enhancing student engagement. Using the three case studies as a backdrop, we present a revised learning analytics adoption framework focussing on strategy, structure, support, and impact, and use this framework to systematically evaluate the implementation of the SRES at the three institutions to derive 'recipes' for adopting an educator-focussed learning analytics platform. We also discuss three core themes emerging from the case studies, around the needs of academics, the role of academic and educational developers, and flexible and agile information technology practices.

Introduction

The changing demands of higher education on teachers

Two prominent features of today's changing higher education landscape are the increasing number and diversity of students and the ubiquitous learning technologies that handle a growing amount of data about students and their learning. Beyond the obvious and financially-impactful problem of attrition, ballooning cohort sizes and increasing use of online teaching modalities threaten to diminish the quality and personalisation of higher education. This challenging landscape has negatively impacted on student learning and student experience, particularly in large first year cohorts (Nelson & Kift, 2005). This can be redressed by better engaging students and helping teachers meaningfully interact with students and provide learning support at scale (Tinto, 1999). However, managing the competing demands of teaching and research is a reality of modern academic life. For many staff, particularly those involved in first-year teaching, this can mean managing very large student cohorts with minimal administrative support. It is in this context that the research field of learning analytics (LA) has grown, promising new approaches and applications for understanding and improving student learning (Siemens, 2013). Practically, LA promises to impact the classroom by improving feedback to students and providing more personalised learning experiences, streamlining administrative processes and data capture to ease logistic

burdens of large cohorts, and providing teachers with deeper insight into their curriculum and teaching approaches (Shacklock, 2016). However, reports from around the world suggest laggard adoption and implementation of LA by institutions and educators (e.g. Bichsel, 2012; Colvin et al., 2016; Shacklock, 2016; West et al., 2015).

Issues with adoption and impact of learning analytics

Recent reports on Australasian LA adoption and implementation have highlighted that, as the primary implementers of any LA tool, educators need to be involved in designing LA approaches that "are sensitive to their environments, meeting and extending their pedagogical requirements, and ensuring flexibility" (Colvin et al., 2016, p. 19). In this context, educators' needs seem to revolve around actions that involve personal contact with their students, balancing the automation of computers with the personal approach of teaching (West et al., 2015). Notably, this report highlighted that educators "still have to make sure that it [communication and feedback] is personalised and meaningful for students" (p. 20), and that educators need LA tools with "some ability to modify it to their own requirements because each course and each cohort of students may differ" (p. 20).

Despite the field of LA being almost a decade old, there is a striking gap in practitioner and research literature on reports of educator-centric LA systems for personalising feedback and communication that have seen wide acceptance and adoption. Additionally, despite calls for more cross-institutional and researcher-practitioner collaboration to impact students and educators (e.g. Siemens et al., 2011), positive reports of successful collaborative implementations are lacking. Reasons for this include a cultural resistance to change, a lack of understanding from management, concerns about academic workload, and simply that the right tools may not yet be available (Colvin et al., 2016; Macfadyen & Dawson, 2012). A fixation on predictive analytics and its reliance on big datasets may also dilute the importance of context, meaning, and personalisation (Gašević, Dawson, Rogers, & Gasevic, 2016; Liu, Rogers, & Pardo, 2015), further contributing to the lack of impact for educators.

A useful comparison for LA adoption may lie in blended learning, which also raises concerns around technology, culture, context, and pedagogy. Graham et al. (2013) proposed a framework to organise their findings about blended learning adoption which spans three developmental stages (awareness/exploration, adoption/early implementation, and mature implementation/growth) and three categories (strategy, structure, and support). One missing component in their framework is impact, which includes effects on stakeholders and benefits to the organisation. In this respect, it is helpful to consider the observations by Ali, Asadi, Gašević, Jovanović, and Hatala (2013) in regards to the LA acceptance model (LAAM). Their model provides important dimensions for considering impact: (1) engagement; (2) responsibility; (3) course design; (4) performance; (5) satisfaction; (6) relevance; and (7) overall usefulness. These may be combined (Figure 1) to evaluate a number of questions regarding the effectiveness of LA implementation, particularly from the perspective of educators, but also question the processes, interactions, and relations between the tools and stakeholders.

Strategy – describes issues relating to the overall approach, including definition, forms of advocacy, degree of implementation, purposes, and policies surrounding use and adoption
Structure - included issues relating to the technological, pedagogical, and administrative framework facilitating adoption, including governance, models, scheduling structures, and evaluation
Support – is related to the way in which an institution facilitates the implementation and maintenance of the tool, incorporating technical support, pedagogical support, and faculty incentives.
Impact – considers the effect (over time, from short to long; on practice, from the team to the broader higher education context) on different stakeholders; also includes questions from the LAAM**.**

Figure 1: Dimensions of the recipes, partly adapted from Graham, Woodfield, and Harrison (2013).

A way forward? Empowering teachers with a context-driven tool, the SRES

In this paper, we apply this revised framework to systematically analyse and evaluate three case studies where Australian institutions have collaborated to adopt and implement the same LA platform. This platform, the Student Relationship Engagement System (SRES; www.sres.io), is a bespoke development initiated by a team of educators from the University of Sydney. In stark contrast to other LA approaches and tools, the SRES shuns predictive algorithms and big data in preference for teacher intelligence and small but meaningful data (Liu, Bartimote-Aufflick, Pardo, & Bridgeman, 2017). Notwithstanding the algorithmic insights that big datasets can offer such as determining predictive factors for student performance and uncovering some structural forces shaping student outcomes (e.g. de Freitas et al., 2015), an important caveat of learning analytics based on big data is that local pedagogical context, and therefore meaning, may be lost (Gašević et al., 2016). Therefore, the SRES' approach enables educators to choose data that

are important for their unique local learning and teaching context (e.g. interim marks, attendance, tutor feedback, in-class participation grades, etc), and helps them to collect, collate, analyse, and make direct use of these data. Critically, educators can use the SRES to efficiently personalise learning support and feedback to students at scale by building simple rules to customise information that different students will receive via email, SMS, or a web page embedded into an LMS. For example, course coordinators can use it to design a mobile-friendly SRES web app interface for tutors to save grades and feedback in class, and then build customised messages to be sent out to different students with suggestions for improvement based on these data. Teachers can also build interactive dashboards to visualise class trends and select sub-cohorts for follow-up. This puts teachers in control of the whole data lifecycle, enabling them to obtain and use contextually-meaningful academic engagement and success data to foster relationships with, and belonging in, their students. McDonald et al. (2016) reported on a closely-related development to this, similarly emphasising the importance of meeting "grassroots classroom needs" (p. 404) when building out a collaborative LA venture.

In the following sections, we reflect on the initial driving factors for development of the SRES at the University of Sydney, and discuss its wide adoption and outcomes. We follow this with reflections on why the SRES was needed at two other Australian universities, how it was implemented, and preliminary outcomes for students and teachers. Finally, we evaluate these implementations using the modified framework presented above, and discuss three critical and common threads around academics' needs, the role of support, and information technology workflows.

Case study 1: University of Sydney

Driving factors

The SRES was initially designed and developed in 2012 within the Faculty of Science at the University of Sydney. The spark behind creating a new educational technology stemmed from pedagogical and pastoral needs not being met by any existing platform at the University or in the marketplace. At a low level, these needs were around an integrated system that could track attendance, efficiently collate data from various sources (spreadsheets, databases), replace manual data collection processes, and then empower teachers to use these data to build targeted communications to students, supporting an improved sense of place, purpose, and connection.

At the time (and even now) there were no effective tools for mass personalised communications, customisable according to context-sensitive data available about students, readily usable by academics running individual units of study. Other systems that did exist at the University operated in terms of fostering a relationship with the University, as opposed to individual teachers, such as those used by and for the careers and alumni offices, university-wide academic integrity initiatives, degree program announcements from faculties and schools, end-of-semester student experience surveys, student union groups, and enrolment and timetabling. However, none of these appropriately met the widespread desire from academics for an approach that afforded scalable and personalised communication with students which did not add to workload (West et al., 2015). Extant tools for efficient communication at scale were built into the LMS (Blackboard Learn at the time), but this was insufficient for the pedagogical requirements for meaningful communication since it only allowed the broadcast of generic announcements. There was no way to offer differentiated information to all, or particular, groups at once. Moreover, there was no way to use data about students to drive or target these communications. There was simply no practical means for individual teachers to reach out to their students except through generic emails with various clauses that would simultaneously present relevant and irrelevant information, or to engage in an extremely labour-intensive effort to collate sets of email addresses for hundreds of students (and write personalised messages) for an equal number of emails to be sent manually.

Development and implementation

Two academics coordinating large first year units with 1000-2000 students per semester decided to develop a simple web-based tool to re-personalise students' learning experiences. Through collegial sharing, the SRES was quickly adopted by like-minded academics. As a side project with little active promotion and no budget, the SRES largely stayed within the Faculty of Science for the first two years. Here, a unit with particularly high attrition and many students co-enrolled in other Science units catalysed the cross-faculty implementation of the SRES before it was adopted more widely. Initial interfaculty spread of the SRES did not stem from any top-down institutional drive, but rather from word-of-mouth recommendations between colleagues with similar pressing needs in other first-year units. Beer, Tickner, and Jones (2014) report a similar trajectory of bottom-up growth in another LA tool at an Australian university, and suggest that this 'do it with' and 'do it for' teachers approach was most effective at gaining initial momentum, as opposed to traditional top-down 'do it to' approaches that are likely to fail.

This organic adoption of the SRES continued primarily in this way over the following two years, until its further spread within the University of Sydney was fortuitously catalysed by a change in staff whereby the two main academics behind the SRES moved from the Faculty of Science to become institutional players in a central

learning and teaching unit. From 2016 when the SRES became part of the offerings coming from this central unit supporting all faculties, its adoption has spread more rapidly but uptake was still based on academic choice due to the usefulness of the software. This has been supported through small increases in availability of technical support from the central unit in the form of hands-on workshops and the central eLearning helpdesk managing simple queries related to access and training requests. Additionally, more focussed development time was available to improve the software in conversation with users' needs. As uptake increased across different schools and faculties, local educational designers from these areas were tasked by their departments to support academics in their use of the SRES. In essence, these designers provided the data and technology skills to connect academics with LA (Arnold et al., 2014).

As a tool largely developed and adopted by individual academics as opposed to an approach initiated or mandated from the top down, the SRES has struggled or received only late adoption in other nodes of influence and power within the University, outside of classrooms. For example, for a long time our instance of the SRES lacked fully automated integration with other key enterprise systems such as the LMS and the SIS due to a lack of coordination with the central Information Communications and Technology (ICT) team. This meant that some processes needed manual intervention from users, including updating student enrolments and importing data from the LMS grade centre via CSV files (although the University's recent move to Canvas has allowed the automation of these). This was the most common issue and improvement request reported by our users. Despite the lack of full automation, this did not deter the vast majority of SRES users who continued to use it because of the significant downstream benefits to staff and students.

Additionally, the unique affordances of the SRES have enabled and encouraged improvements in other workflows. For example, tutors can access the SRES mobile web app to view and enter grades and feedback, which are saved to the SRES database and can be used in the form of targeted and personalised emails or HTML pages; previously this workflow was entirely manual and paper-based (with associated data integrity and security risks), or even non-existent, making the provision of timely feedback to students difficult or impossible. The ability to capture, collate, and use different data for different purposes depending on learning and teaching contexts is a core ethos of the SRES, and one that resonates strongly with teachers; this approach empowers their agency as educators as opposed to top-down approaches which are typically prescriptive and deterministic.

Because the data brought into the SRES are those already available to teachers (e.g. assessment grades, feedback, LMS access) or collected live by teachers (e.g. attendance, comments, grades), issues around ethics and privacy presented by other LA systems are less of a concern. These large-scale centrally-managed LA systems typically leverage data warehouses that bring in big datasets (e.g. WiFi access, library usage, demographic background, academic history, socioeconomic status), which may risk labelling or discriminating against certain students based on their background and learning approaches (Prinsloo & Slade, 2013). In contrast, the SRES focusses on 'small data' (Berman, 2013) and the subsequent actions that are inherently meaningful to teachers and their students. This has meant that it generally fits within guidelines around how academics may already use the LMS and tools already available to them. This allows teachers and pedagogy to drive the need for analytics rather than trying to find a home for generic approaches to LA. Finally, and perhaps advantageously, its use has always been optional rather than mandated; a sense of choice and freedom in academic selection of educational technology systems avoids issues around programs mandated by senior management (Macfadyen & Dawson, 2012).

Outcomes and next steps

The SRES is currently used in 17 schools/departments at the University, effecting personalised learning and support for over 20,000 students in over 100 units of study. Academics have chosen to use it because the SRES fulfils a need not adequately met by other available options. They have also reported multiple benefits including better connectedness with students, increased performance, better student engagement with learning resources, increased attendance, and reduced attrition (Liu et al., 2017). An open and non-restrictive faculty leadership and policy environment has also supported the SRES through allowing academics to use educational technology in innovative ways, but without any formal support or endorsement coming from the senior management.

The main hurdles have come from the restrictive policies around information management concerning student records and from a lack of engagement or support from the central ICT teams who are often equipped to deal with external, commercial systems rather internally-developed innovations. The primary outcome from this hurdle has been a lack of systems integration which has resulted in (until recently) a residual and technologically unnecessary administrative burden on academics to manually connect the SRES to source systems through a download/upload method. One of the challenges in aligning the SRES with enterprise implementation approaches will be ensuring that the flexibility and agility of innovation, which has served the project well so far, is

not stifled by the predominantly managerial and relatively static mindset of ICT departments (Jones & Clark, 2014). Previous reports of LA tools that have been scaled by involving central ICT have resulted in significant loss in functionality caused by forcing an initially user-driven design into an inflexible software framework that could not tolerate idiosyncrasies (Lonn, Aguilar, & Teasley, 2013). In that situation, the slight gain in extract-transform-load automation was accompanied by a less nimble solution that presented an "irreconcilable challenge to the ability of the system to scale beyond the [initial] community of users" (p. 238).

Therefore, despite some additional administrative workflows, the SRES has been successful in being adopted by so many academics at the University of Sydney as it is a flexible and bespoke system adapted to academics' felt needs. This is in sharp contrast to the typical technologist-designed educational technology tool where academics are expected to fit their teaching approaches into a fixed menu of options. Rather than operating as a fixed product or with extended development roadmaps, the SRES is a home-grown system actively developed by members of staff, allowing greater efficiency and an improved sense of ownership in our collegial user base. This 'bricolage' model of user-centred design, development, and implementation has been identified as a necessary approach that promotes wide stakeholder involvement and acceptance in LA (Colvin et al., 2016; Ferguson et al., 2014; Jones & Clark, 2014).

Case study 2: University of Melbourne

Driving factors

In the Faculty of Science at the University of Melbourne, the effective management of, and communication with, large first-year cohorts pose significant challenges for teaching staff. Although the University supports a commercial LMS, many Schools use their own student management systems that have generally been grown over time in an *ad hoc* manner to deal with individual Schools' needs and reporting requirements. However, there are security risks involved in storing student data on discrete databases and their management is resource-inefficient. At the same time, the exploitation of data to support student learning (encapsulated in LA) has seen significant growth. From a faculty perspective, the use of local databases means that data, such as that on student attendance and performance, across a program of study is not readily available.

Our interest in the SRES started when one of its lead academic developers from the University of Sydney gave a presentation at the University of Melbourne describing how the system was successfully being used to personalise learning support for large cohorts of students in many units of study. The Associate Dean (Undergraduate Programs) in the Faculty of Science had been interested in exploring systems that would provide data on students' attendance and performance, particularly to identify students-at-risk and allow early intervention to support such students.

Whilst there are many commercial LA products available, there was still a significant disconnect between the utility offered by these technologies and everyday instructors' need to integrate actionable items from these tools into their learning environments. The rapid evolution and adoption of the SRES at University of Sydney provided evidence that academics valued its effectiveness in improving learning outcomes for students. However, the decision to adopt the SRES was strongly influenced by previous relationships between the academics. As noted in King and Cattlin (2017), when academics seek solutions to challenges in their teaching, they most often turn to a trusted colleague for advice. The Associate Dean had seen the development of the SRES at national learning and teaching fora over a number of years, and previous collaborations and discussions with the developer had built the degree of confidence needed to embark on a pilot of the SRES.

Although the importance of engagement and enrichment of the learning and teaching experience is universal in the higher education sector, each institution's learning and teaching context is different. The fact that the SRES can be customised to work in many contexts was an important consideration in our decision to pilot it. A key attraction of the SRES has been the direct engagement with academic staff and its ability to meet specific in-class needs, which may be different from subject to subject. In addition, early results suggested increased student retention within subjects where the SRES has been deployed (Liu et al., 2017). The SRES platform provides instructors with ultimate control over data and the deployment of various actions. For us, this approach addressed three objectives: (1) to promote a data-driven pedagogical approach to aid learning and teaching; (2) to provide a platform for data management which was user friendly to encourage adoption; and (3) to improve the data literacies and competencies of instructors. Taken together, the successful track record, flexibility, and accessibility of the platform made the initiative for collaboration with Sydney even more appealing. This was cemented by another visit by the lead academics and developers of the SRES, which led to the tool and its philosophy being embraced by many academics within the Faculty.

Implementation

From the outset, both the Universities of Melbourne and Sydney were committed to maintaining the same development and philosophy as that already developed at Sydney, which was to work in partnership with teaching staff to implement a system that would help them to

increase student engagement. Close support and collaboration with the SRES lead developer was crucial for its initial implementation since it was being installed for the first time. The implementation stage commenced in November 2016 and the lead developer worked closely with the ITS (Information Technology Services) group at Melbourne (specifically with Faculty of Science ITS staff) to have the system ready for use in Semester 1, 2017. Contributing to this rapid rollout was the relative speed at which an ITS-provisioned virtual machine could be deployed, and connectivity provided to various services such as authentication and email servers. Additionally, the implementation of the SRES at Melbourne demonstrated that as an open source platform it could be deployed at other institutions with a minimal amount of customisation.

While the technical setup was occurring, an academic developer in the Faculty held preliminary discussions with the academics who, after being introduced to the SRES at a seminar given by the SRES lead academics, had expressed an interest in being involved in a pilot study. These academics identified two high-level system requirements: it needed to (1) directly support student engagement; and (2) support academics to teach. Our discussions with academics also identified class engagement and attendance data were important, in keeping with evidence-based practice (Credé, Roch, & Kieszczynka, 2010). Interim grade and other performance data were also relevant to academics. Using these as guiding principles, specific use cases were developed with these academics in six subjects across the Faculty.

To aid smooth implementation, training was provided by the lead developer from Sydney to the academic developer at Melbourne who was working directly with the pilot academics, following a train-the-trainers model. Fortuitously, a new software developer in the Faculty's ITS team also took on the role of technical support for our installation of the SRES, conducting various system tests and fine-tuning configurations. This software developer has also started to contribute to the open source development of the SRES. Alongside the technical development and training, the project team (initiated by the Associate Dean) ran information and training workshops with academics and sessional staff to introduce them to the system and to demonstrate practical applications. Close collaboration between the Sydney developers and Melbourne developers continued throughout the implementation phase to discuss issues that arose, technical queries, and pedagogical approaches to student support. Together, these contributed to a rapid implementation cycle from initiation to piloting in live subjects.

Outcomes and next steps

At the time of writing, the pilot at the University of Melbourne for Semester 1 has just concluded. The development team worked closely with academic staff in large (some over 1350 students) and small subjects to pilot the SRES. The system was used to mark attendance, enter live grades, and send personalised emails to students based on criteria set by, and important to, individual academics. Each context is unique and thus triggers for actions varied depending on the teaching and learning requirements in a subject; the SRES was able to accommodate this variation. Our experience of the pilot thus far is perhaps best summed up in the following testimonial from an email circulated from one of the subject coordinators to the project leader at the University of Melbourne after the first communication was sent to students: "*Over 445 personalised emails [were sent] to students. The students [were] assigned to three different teaching streams and received a unique message from the subject coordinator. The time spent working through data, wrangling technical issues with our barcode scanner to mark attendance, as well as quality control of the communication was well worth it. The sent out email certainly resulted in responses from students, including positive responses like "you have boosted my confidence" and "thanks for the information I will see a tutor on duty for help" and "I need to sort out my consideration" etc.*"

We experienced some minor issues around the new technology-driven approach which were resolved through training and workarounds. Interestingly, we also observed pushback from some sessional staff who objected to using mobile devices in class to access the SRES; preferring to use hard copy to mark attendance with later transfer into the SRES. Later they moved on to using iPads to avoid double handling data and extra work. After further explanation and assurances about student experience and workload, the staff continued with the pilot. Generally, the feedback from academics, tutors and ITS staff to date has been positive, encouraging, and enthusiastic. In Semester 2, we hope to see the project progress to a point where the impact of the SRES on student engagement and learning can be systematically evaluated.

Case study 3: University of New South Wales

Driving factors

There is a key strategic driver which makes the landscape at UNSW fertile for the implementation of tools like the SRES: improving the student experience which is at the core of the 2025 Strategy (http://www.2025.unsw.edu.au). Together with a re-prioritisation toward excellence in teaching, the strategy is characterised by a focus on digitization (shifting

towards blending technology into learning and teaching) and personalisation. An important feature of UNSW is that it is a large, research-intensive university relying on a distributed organisational structure. This means that several initiatives often start at the local level (i.e. schools and programs) and are pushed from the periphery to the centre (a bottom-up approach) when there is a critical mass supporting them. In this sense, there are numerous examples of innovation and excellence in learning and teaching which started this way (such as SmartSparrow and REVIEW). Another important factor has been the timing of a separate project funded by the now-defunct Australian Government Office for Learning and Teaching aiming to develop a tool ('OnTask') to personalise support actions. The early development process of OnTask made it possible to initiate conversations with interested academics and set up pilots intended to experiment with the new tool. Yet, because of some delays in the development of OnTask, using SRES was taken as a concrete, viable alternative for the personalisation of communications with students.

Implementation

Initially, four course conveners volunteered to pilot the OnTask tool, and so were redirected to the SRES. They convened introductory courses across faculties, characterised by two fundamental problems: (1) very large and diverse cohorts (between 800 and 1600 students) requiring a lot of time and effort to coordinate numerous tutorials/labs classes; and (2) an aspiration of the lead educators to make the interactions with students more personal and relevant.

Leveraging some internal capacity in the PVC Education portfolio, an Amazon instance (C4.Large, EC2 Linux) was created, including setting up of the database and security and defining the basic rules and protocols for access and use of the service. A close cooperation with the SRES lead developer was essential given that the service did not exist at UNSW and we accomplished an incredibly rapid rollout of a usable SRES environment within just two weeks, before the start of semester. The successful implementation demonstrates that it is possible to deploy the SRES for a pilot relatively quickly, benefiting from the experience accumulated in the SRES project with multiple institutions. As highlighted by Lonn et al. (2013), we felt this was necessary to capitalise and champion academic enthusiasm without compromising the nature and capabilities of the SRES system.

The support channels for this pilot were limited to one-to-one relations between one academic developer in a central learning and teaching unit and the academics in the faculties. The main strength of this approach was the ability to maintain a strong personal link with the academic leads partnering in the project and provide *ad hoc* support. This was essential to ensure trust, flexibility and responsiveness, all of which made the outcomes of the project more likely to succeed and provide value for those involved. The biggest weakness was one of capacity and scalability: the workload required to manage the data collation and preparation for all these courses in the first few weeks of the semester was challenging and the sustainability of the project was highly dependent on those involved. Although the latter may not be a critical risk for a pilot, it may affect longer term uptake and impact of the implementation. Solutions to this involve a move to the elusive automation of data flows from enterprise systems, or an approach similar to the earlier stages at the University of Sydney where committed academics and their local support staff took on this role.

A notable feature of the continued conversations with the academic leads of these courses was that they expected all data (such as updated enrolment, class registration, and LMS data) to come automatically into SRES. This has not been the case in the UNSW implementation thus far, because direct access to other university systems was not possible to implement in the short timescale and remains one of the major obstacles to any LA tool's implementation. However, the affordances of the SRES provided an opportunity to improve the data capture in the courses as it allowed tutors to take attendance on the fly and assign class participation grades from their mobile devices in class (a massive improvement compared to the asynchronous data entry from several spreadsheets). It also allowed academics to collate information from different systems (including the LMS, external tools, class exams) and give a single point of contact for the course conveners to take the pulse of what is happening at any point in time of the semester.

Outcomes and next steps

The SRES's major achievements at UNSW were in the streamlining of data collection for tutorials, and its ability to send customised feedback to students at regular intervals. With the inbuilt roster view, the SRES was a winner with both course convenors and tutors; for the first time in these courses, conveners had the ability to view at-a-glance the status of attendance and class performance without having to scramble together several spreadsheets and lists. This provided considerable efficiencies and enabled them to quickly confer with tutors to address potential issues. The SRES also allowed us to explicitly articulate the feedback that academics may give to students in a more personalised way.

Even though ours was a small pilot with four courses, we started to push the limits of the SRES because of the nature of the courses (very large) and the complexity of the data gathered (up to 180 different features/columns to be imported into the SRES data store at once). This was in contrast to how the SRES had been used at Sydney and Melbourne; at those institutions, academics were very

selective about the data that were meaningful to include, which meant that each course (even very large ones) only had up to 30-50 features/columns. The large number of features in our pilot started to push the SRES beyond its primary purpose of enabling teachers to work more effectively with lots of 'small data'. In one of the largest courses on campus, the sheer volume of students (1600+) and columns (150+) made it very hard to load the entire set of data for all of students at once in the browser, and required tweaking of the various server settings as well as the way in which previews and message queues were built. A relatively smaller course (800+ students) also provided some challenges which were quickly resolved as problems occurred. These changes improved the stability of the system, but the challenges posed by technical difficulties made the academic partners somewhat restless. Through implementing the SRES with these pilot courses, significant improvements were made to the software itself, following the user-driven approach taken at Sydney.

The pilot demonstrated the need and value of tools such as SRES to support course logistics/admin and empower academics with the ability to support students with personalised communication and feedback. More work will be needed to establish process and protocols to automate data feeds into the system and resolve the issues of system scalability. Yet, putting academics at the centre was essential in creating stronger engagement with the students. This was clearly demonstrated by the rate of email opening and feedback left in the SRES about the value of the nudges provided by the course leads.

Discussion

In this paper, we set out to provide *recipes* for institutional adoption of the SRES. After describing the three cases, which help to contextualise both differences and similarities, it is worth taking a few steps back and evaluating the cases through existing adoption and implementation models. In particular, the synthesis between a blended learning implementation framework (Graham et al., 2013) and the LAAM (Ali et al., 2013) presented in the introduction provides a scaffold to systematically analyse the cases and to extract *recipes* out of them (Table 1). Using this synthesised framework, it is possible to compare the cases and provide an informative starting point for others who may be following a similar pathway. Building on these, the three case studies have also highlighted a number of lessons and their implications for others undertaking similar approaches. The review of the cases allows the identification of three core elements.

Firstly, the key driver for initial adoption was to meet academics' pressing needs. Academics are the key implementers of LA, and LA has a "greater focus on informing and empowering instructors" (Siemens & Baker, 2012, p. 253). As Colvin et al. (2016) pointed out, "implementers require an analytic tool or combination of tools that manage data inputs and generate outputs in the form of actionable feedback" (p. 30). The ability of the SRES to help academics collect and collate data, and provide personalised learning support to students, resonates strongly with this. In this context, it is important to note that the utility of this particular tool is not just about personalised emails generated from rules acting on imported, already-collected data. Instead, it is crucial that the tool is able to support the whole data lifecycle as experienced and needed by educators, which includes streamlining (or indeed enabling) the electronic collection of data itself.

Secondly, the implementation process is catalysed by staff who can connect academics with LA tools. These staff may be, as in our case studies, in educational or academic developer roles within faculty or central learning and teaching units, and not necessarily dedicated data scientists. However, this is likely due to the SRES being unique in the LA field in that the data/variables chosen and what actions are derived are determined primarily by the academic or course designer. This is in stark contrast to the usual LA approach where predictive modelling or statistical expertise is required to understand standardised pre-existing data harvested from existing and readily-available electronic sources (Arnold et al., 2014). Instead, in our context the educational or academic developers helped to bridge the gap between software (as opposed to just ‘data’) and pedagogy.

Table 1: Recipes and reflections of adoption of the SRES at three Australian universities

	University of Sydney	University of Melbourne	University of New South Wales
Strategy			
Purpose	Better engaging students in growing cohorts; aiding student transition; increasing strategic use of LA	Improve student engagement in large cohort classes, increase learning and teaching satisfaction for students and staff; provide access to faculty-wide data on student engagement	Alignment with 2025 Strategy and the four pillars for education: 1) inspired learning through inspired teaching, 2) digitization; 3) feedback through dialogue; 4) building communities
Advocacy	Support from DVC(E) and staff in the portfolio; academics and professional staff championing innovation and sharing practice	Faculty of Science academic initiative in innovation around student engagement/experience improvement	Support from PVCE to fulfil the strategy; academics championing innovation; support in managing large courses
Implement-ation	Teams of academics, sessional teachers, and professional staff using the SRES	Lead developer from Sydney, academics, tutors, local ITS staff from Melbourne	Individual faculty members piloting SRES
Definition	LA to improve students' learning experience and outcomes	No universal definition of terms/uses	No universal definition of terms/uses
Policy	Part of strategic plan for educational innovation; open experimentation	No specific policy, open experimentation	No specific policy, open experimentation
Structure			
Governance	Course coordinators use the SRES to enable and augment workflows; limited oversight in some faculties	Subject coordinators decide to use the SRES	Internal support from PVCE and custom support
Model	Free adaptation and use by academics; some local sharing of best practice models	No institutional models established	No institutional models established
Scheduling	Academics self-select	Academics self-select, no planning or selection of subjects	Quick response to academic needs; no specific planning or selection of courses
Evaluation	Student engagement, satisfaction, retention, and academic performance; staff feedback	Student engagement, satisfaction, staff feedback	Student engagement, satisfaction and performance; staff feedback on process and tools; consideration of the sustainability of process
Support			
Technical	Staff from DVC(E) portfolio train the trainers and academics; educational designers embedded in faculties; academic champions providing ad hoc support	Support of lead developer from Sydney in training academic developer who provided ad hoc support; local ITS support	Internal provision from PVCE to support pilot; no central IT support, partial support from local teams
Pedagogical	Enhancing feedback and learning support	Enhancing feedback and learning support	No fundamental changes in course design, BUT consideration of 'learning conversations' and how to support logistics/management of courses
Incentive	Workload reduction; increased student engagement and feedback scores; intrinsic reward as dedicated teachers	Engagement and feedback scores; increase student learning satisfaction	Education-focussed careers; funding support for 'Inspired learning initiatives'; 'Lazy user model' (Collan & Tétard, 2007)
Impact			
Students	Improved connection with staff; improved engagement, satisfaction, performance; enhanced feedback provision; reduced attrition	Enhance connection with staff; improved engagement based on student feedback	Improved engagement and satisfaction; improved learning?
Academics	Improved connection with students; streamlined workflows and workload reduction; increased data literacy; new data-driven workflows enabled	To some extent improved connection with students; increased data literacy for student support	Positive reaction to admin streamlining; increased consideration of learning and student support
Support staff	Streamlined workflows and workload reduction; open conversations on learning support; increased data literacy	Further training and support required for broader involvement. Open conversations on learning support; increased data literacy.	Will need broader involvement and training
Management	Reduced attrition; moving institution to increased data literacy and data-driven actions	Contribution to increased data literacy; increased consideration of learning and student support	Contributing to fulfilment of KPIs

Finally, flexible and agile ICT practices (or at least dispensations) are critical for providing the necessary infrastructure. This is important to maintain momentum once a decision to pilot or implement has been sparked, as well as to preserve as much of the original functionality (and therefore expectations that implementers have) of the tool as possible. If LA adoption is a 'pipeline' problem, rapid deployment (and development) helps to ensure that implementers do not fall back from interested to not-interested (Colvin et al., 2016; Liu et al., 2015). Another key infrastructural element observed in our case studies was the (not unreasonably) pervasive expectation of systems integration - that the SIS, LMS, and SRES would all interchange data freely and automatically. While most LA initiatives depend on data warehousing solutions (Shacklock, 2016), in our experiences most of the data that academics considered meaningful and wanted to use for providing personalised learning support were either not captured in any existing database (such as attendance, in-class notes, and interim grades and feedback), or could be simply imported through a basic CSV from source systems (such as LMS gradebook data). In fact, academic freedom to teach how they wish often means that desired data are not 'available' to traditional LA approaches (West et al., 2015); the SRES affords the opportunity to modify existing workflows so that these data can be captured electronically.

At time of writing, preparations are in place for pilots of the SRES at two other Australian universities, sparked similarly by academic needs. We aim to follow a similar approach to the existing three implementations, and warmly invite other interested parties to collaborate.

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