

## Cross-institutional collaboration to support student engagement: SRES version 2

**Jenny McDonald**

Centre for Learning and Research in  
Higher Education (CLear)  
University of Auckland

**Danny Liu**

Educational Innovation Team  
Faculty of Science  
The University of Sydney

**Adon Christian Michael**

**Moskal**  
College of Enterprise and  
Development  
Otago Polytechnic

**Richard Zeng**

Higher Education Development  
Centre  
University of Otago

**Marion Blumenstein**

Centre for Learning and Research  
in Higher Education (CLear)  
University of Auckland

**Cathy Gunn**

Centre for Learning and Research  
in Higher Education (CLear)  
University of Auckland

**Steve Leichtweis**

Centre for Learning and Research in  
Higher Education (CLear)  
University of Auckland

**Abelardo Pardo**

School of Electrical and  
Information Engineering  
The University of Sydney

Descriptions of cross-institutional, educational technology development initiatives that emphasise what actually works in real-world classrooms are rare. In this paper, we describe a multi-institution collaboration that grew from grassroots classroom needs and proved resilient in the face of institutional change. We explain how the initiative came about, how it survived unanticipated change, and how it led to the development of a new open source learning analytics tool for student engagement. We provide some reflections on the first pilot study of the tool and describe future plans. The authors welcome new collaborators and invite interested readers to evaluate and extend the tool for themselves.

Keywords: Educational technology, collaboration, open source software development, student engagement

### Background

In the first edition of *Rethinking University Teaching*, published in 1993, Diana Laurillard remarked that educational technology “has an odd mix of engines driving it – technological pull, commercial empire-building, financial drag, logistical imperatives, pedagogical pleas” (Laurillard, 1993, p. 99). More than two decades later, the odd mix of engines has arguably become louder, faster and even more diverse. Higher education institutions today are under increased pressure to demonstrate effective return on investment for students, particularly in areas of technology-enhanced teaching and learning (O’Flaherty & Phillips, 2015). Central to enhancing teaching and learning with technology is the educational technologist.

The role of the educational technologist falls into what Whitchurch (2008) has described as the *third space*; a challenge to the prevailing binary view of university employees as either academic or professional (sometimes general) staff. Gornall (1999) identified that educational technologists play strategically significant roles within the institution, yet seldom occupy mainstream academic roles. Oliver (2002) characterised the growing number of educational technologists as people who work collaboratively and responsibly, but without specific authority, on curriculum-centred projects. In this respect, they arguably share a similar uncomfortable space to academic developers (Kensington-Miller, Renc-Roe, & Morón-García, 2015). Indeed, in the Australasian context, they are often co-located within centres for academic development (Hicks, 1999), may have designated academic or professional roles and are often at the mercy of repeated cycles of restructuring (Palmer, Holt, & Challis, 2011).

Paradoxically, as educational technologists and academic developers navigate their liminal third space in the face of measures which privilege individual academic specialisation (e.g. in New Zealand the Performance Based Research Fund, or PBRF), collaborative, pedagogically-motivated, institutional projects, and the place of educational technologies have arguably become pivotal to the very future of higher education. The notion that a technological ‘silver bullet’ or ‘killer app’ will come along to revolutionise education has largely been put to bed (Pinto, 2016) and the focus of educational technology has shifted to collaborative, multi-perspective initiatives, with an emphasis on what actually works in real-world classrooms (Latchem, 2014).

In Laurillard’s terms, the ASCILITE 2016 conference theme, *Show me the learning*, is a clear “pedagogical plea” to demonstrate what works in the classroom. Recently, learning analytics researchers have echoed this theme and suggested that learning analytics is occurring in a theoretical vacuum; the problems being solved are seldom informed by pedagogical theory and solutions fail to generalise beyond local contexts (Kirschner, 2016). In this paper, we respond to the ASCILITE conference theme by describing a cross-institutional collaboration that began following ASCILITE 2015. The learning we describe is that of the authors with respect to the cross-institutional development of a pedagogically-motivated learning analytics tool for student engagement. In-class case studies are currently underway to evaluate the tool in a range of pedagogical and institutional contexts and will be reported elsewhere. While cross-institutional collaboration is not novel (e.g. Apereo foundation projects such as Opencast and Sakai; JISC Learning Analytics project), developmental collaborations that grow from grassroots are rare and narratives around how to embark on this kind of collaboration, and how such collaborations progress, are seldom discussed in the literature. This paper aims to address that gap and begins with the motivation for developing a learning analytics tool for student engagement.

## Hatching a development plan

The retention and progression of diverse, first-year student cohorts are issues facing many higher education institutions (Tinto, 2006; West et al., 2015). Exacerbating this is the inertia and disconnectedness that students often feel, which could be in part alleviated through targeted support (Krause, 2005). Therefore, regular, personalised communication and feedback between teachers and students can be central to enhancing student engagement and supporting students (Chickering & Gamson, 1987; Kift, Nelson, & Clarke, 2010). Fundamentally, this should never just be about the at-risk cohort or for the purposes of retention, but rather improving the experience for all students. However, the ability for teachers to connect with their students is being increasingly diluted through massification, a problem that a pedagogically-motivated tool could address. The Student Relationship Engagement System (SRES), developed by author Liu from the University of Sydney, is a web-based system which combines a central repository of student data with a means to efficiently bring in data and then utilise these data at scale to personalise support and interactions with students (Liu, Bartimote-Aufflick, Pardo, & Bridgeman, 2016, forthcoming). Data can be imported from existing sources (e.g. LMS, spreadsheets) or entered *in situ* using a mobile application (e.g. attendance in a lab, comments in a tutorial). Data can be easily collated and combined by teaching staff for a range of purposes. For example, to automatically identify and send a personalised email or text to students who have: missed more than two labs in a row; or submitted assignments late; or performed poorly in early summative tests etc. Underpinning the SRES is a belief in ‘bottom-up’ learning analytics, empowering teachers to gain actionable insights from their own local data (Liu, Taylor, Bridgeman, Bartimote-Aufflick, & Pardo, 2016) instead of having learning analytics delivered to them from centrally-managed projects.

Use of the SRES has grown rapidly at one university (55+ courses across 14 departments since 2012) and key to its success has been direct engagement with teaching staff and meeting specific in-class needs. In addition, early results suggest increased student retention within courses where the SRES has been deployed (Liu et al., 2016, forthcoming). Authors McDonald and Gunn met with author Liu at ASCILITE 2015 and seeing the potential for SRES use at their own institutions invited him to visit in February 2016, following the conference. Author Liu gave workshops/seminars at the University of Otago and the University of Auckland, each of which was attended by around 30 teaching staff from the host and other local institutions.

Although the SRES was built as an open source project that could be transferred to other institutions with a small amount of customisation, it was developed on a dated web application platform and hard-wired into university systems. Together, the authors agreed that the ideal approach would be to redevelop SRES from the ground up as an open source project utilising a modern scalable architecture. In this way, project partners could develop SRES v2 to meet their own specific needs but benefit from sharing a flexible data architecture and common components. For example, data import or barcode scanning interfaces for data input, or messaging components and visualisation tools for data output. Furthermore, this approach lent itself to bringing new partners into the project, sharing the development load, ensuring sustainability and increasing the benefits for all. As Latchem (2014, p. 5) notes, educational technology ‘failures’ tend to result from “too little attention being paid to the pedagogical, organisational, cultural and other factors that determine what fails, what works and what transfers successfully into other contexts”.

One remaining issue was how to fund the redevelopment. Authors Gunn and McDonald were fortunate to have been awarded an Ako Aotearoa National Project Fund Grant in 2015 from the New Zealand government, and were able to include SRES v2 development and evaluation as a case study in this research. SRES v2 development began at the University of Otago and for reasons that will be discussed, has continued at the University of Auckland.

## Development and implementation progress so far

From the outset, the authors were committed to maintaining the philosophy of the original SRES, which was to work in partnership with teaching staff to create a system that would help them to increase student engagement. One criticism lobbed at today's educational technology is of being driven by "issues of enhanced organizational effectiveness and efficiency, rather than individual or collective empowerment" (Selwyn, 2013, p. 34). For example, this year the University of Auckland moved from a largely home-grown and bespoke learning management system (LMS) to a cloud-hosted solution. The move brought with it a heightened expectation from various stakeholders to leverage the new LMS to gain insight, in a more user-friendly way, into how students learn and perform. Our approach with SRES v2 deliberately sought to empower teachers by including them early and often in the development process, specifically formulating use cases around their current in-class teaching practices. In the case of the University of Auckland, this involved working with data from the new LMS.

## Working with teachers to build use cases

Preliminary discussion with the teachers who had expressed an interest in being involved in a pilot study identified two high-level system requirements: 1) directly support student engagement; and 2) support teachers to teach. Using these as guiding principles, specific use cases were developed with these teachers in four courses across two institutions, based on their in-class experiences.

Use cases were categorised as either 'input' or 'output' cases: input cases typically involved inserting data into the SRES v2 (e.g. via uploading a spreadsheet of student data, or using a mobile app to record data *in situ* during class, such as attendance), while output cases were centred on reading, displaying and communicating data contained within SRES v2 (e.g. filtering student data based on certain criteria and then sending a personalised email to the students concerned). Cases were written in a standardised format using active language, along the lines of "As a [teacher/demonstrator/course coordinator/etc], I want to [do something/see something]" to encapsulate the value the system would add, and how interaction would take place (Paetsch, Eberlein, & Maurer, 2003). Two example use cases are shown below:

### *University of Otago*

Two first-year biological science classes (~150 and ~300 students) and one second-year biological science class (~130 students)

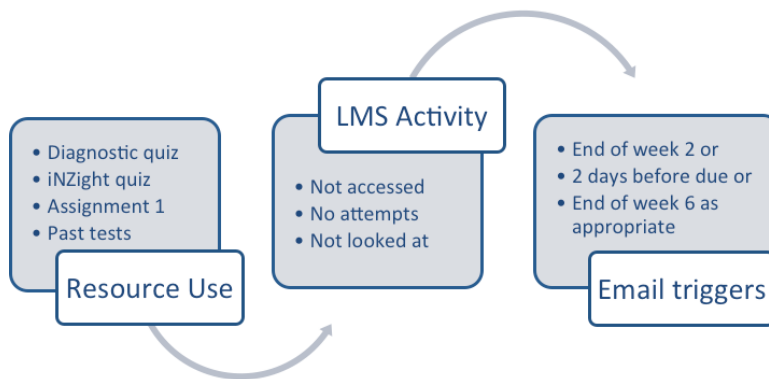
- Example input use case: As course coordinator, I wish the [course] teaching fellows to be able to record student assignment grades and submission dates via the University LMS to check for progress and late assignments. This data should be imported from the LMS.
- Example output use case: In large classes it is often impractical to personalise communication to students and offer support before it is too late. Ideally, as course coordinator, I wish the [course] teaching fellows to be able to identify students who have not checked their grades on Blackboard by week X, notify them and offer follow up via email or text message.

### *University of Auckland*

First-year statistics class (1700+ students)

- Example input use case: The [course] team would like to record students' use of LMS resources (specifically their participation in diagnostic quizzes and looking at a previous statistics test) in order to monitor activities in preparation for their first assignment. This data should be imported from the LMS.
- Example output use case: As [course] academic student adviser, I'd like to encourage student participation and offer further assistance. Therefore, I wish to identify students that have not accessed either the diagnostic quiz, or the iNZight quiz or looked at the first assignment by the end of week 2 in order to send an email or text message to those students

Working from these use cases, Figure 1 illustrates potential action triggers for an email or text intervention, based on students' use of specific course materials. It is envisaged to not only monitor students' engagement with the LMS but to also closely monitor students' performance during the course of the semester. For example, a teacher can filter students who correctly answered less than 5 out of 8 questions in the diagnostic quiz and then send a personalised email message to those students offering extra statistics support.



**Figure 1: Process diagram of possible data triggers to monitor students' engagement for follow-up**

The collection of use cases, developed in partnership with teaching staff, informed the development of SRES v2 and through an iterative development process culminated in the development of the minimum viable product (i.e. the minimum functionality of the software which could be used in practice by the target users) for SRES v2.

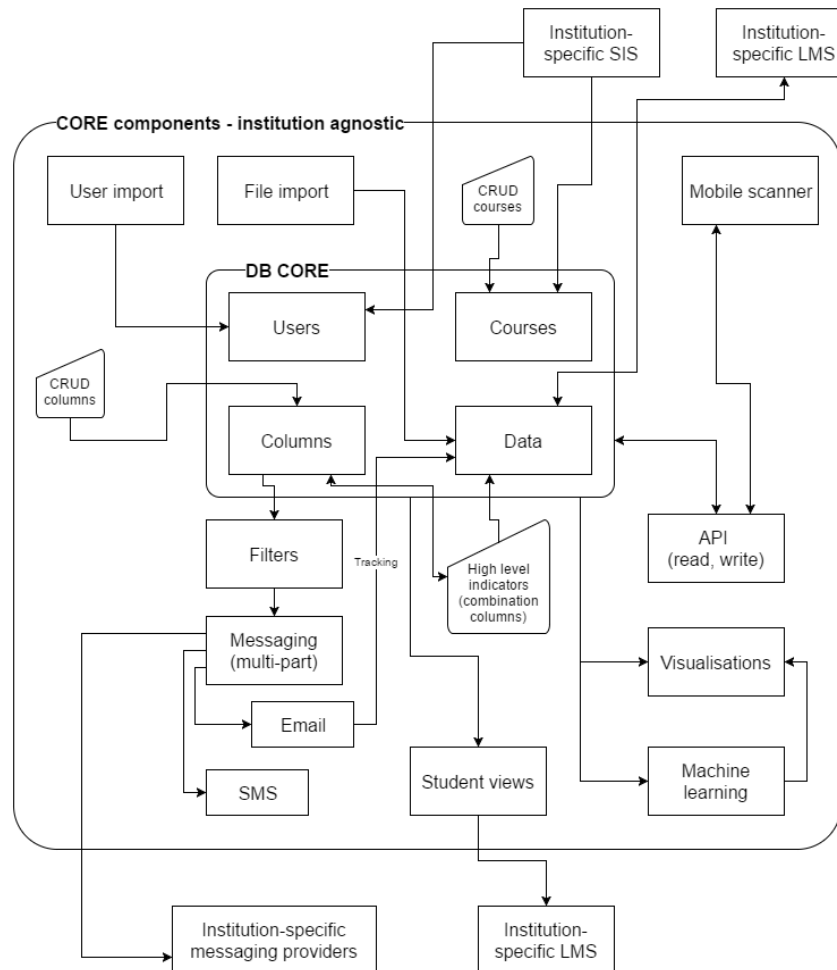
### **Building the minimum viable product – SRES v2**

We were encouraged by recent reports of learning analytics initiatives at Australasian institutions which highlighted the need to provide teachers with flexible, user-friendly tools that met their pedagogical needs and the desire for teachers to be in contact with their students (Colvin et al., 2016; West et al., 2015). Specifically, Colvin et al. (2016) espoused a 'rapid innovation cycle' approach where small-scale learning analytics initiatives could be trialed, and evidence of their impact collected, before scaling up. Our development of SRES v2 closely reflected these themes, working together with teachers to build up to a minimum viable product that would meet their most pressing needs.

Based on the philosophy of the original SRES which took a human- and teacher-centered approach on a platform capable of flexibly absorbing data and producing customised learner support (Liu et al., 2016, forthcoming) a key initial step in SRES v2 development was to establish a flexible system architecture which could be simultaneously institution agnostic, but eminently understandable by teachers. The core database architecture therefore consists of collections of courses, users (students and teachers belonging to courses), columns (belonging to courses), and data (information in the columns) (Figure 2).

For instance, student data are represented in the system as 'columns', chosen for compatibility with existing information paradigms to which teachers are accustomed; that is, spreadsheets with the ability to customise as many columns as needed. Experience with the original SRES gave us confidence that this was effective at bridging the gap for teachers. To enable this flexibility on a modern programming architecture, MongoDB was selected due to its exceptionally flexible key-object data representation. This meant that each teacher could have entirely different sets of columns (and data) for each course. This flexibility was important as others have identified that course context is critical in meaningfully applying learning analytics (Graf, Ives, Rahman, & Ferri, 2011; West et al., 2015).

The system architecture (Figure 2) was designed around key input, output, and input/output programmatic and user interfaces. For example, based on our use cases, teachers wanted to collate grades and attendance from spreadsheets and class sessions, which needed import functionality as well as a mobile app, respectively. Using these data, teachers wanted to identify particular segments of their cohort and engage with those students, which needed filtering and messaging functionality. At the time of writing, the majority of the core system architecture is implemented in the minimum viable product, while the student views, machine learning, and complex visualisations have yet to be developed.



**Figure 2: System architecture for SRES v2. Input and output interfaces are shown with arrows leading into, or arising from, the database core, respectively. Input/output interfaces are shown as double-ended arrows.**

The SRES v2 user interface provides a step-by-step guide to setting up a class, importing or entering data, selecting students according to pedagogically-informed and -relevant criteria and setting up easily customised email templates. Student enrolments and data can be imported into SRES v2 through uploading spreadsheets, and additionally we are developing a mobile app that allows instructors to enter data on the go directly into the system. The main interface revolves around the student list which consists of rows of students and columns of data, which is familiar to all teachers (Figure 3). From this interface, teachers can directly apply ‘filters’ to the data to generate a subset of the list, and then contact the filtered students. These filters are based on simple operators such as ‘equals’, ‘less than’, etc. This dashboard also has simple visualisations which display the relative frequency of data in each column, as well as a log of the messages (interventions) that have been delivered to students. When teachers compose messages to students (Figure 4), any data that are stored in the list can be brought into the message. By incorporating ‘shortcodes’ into the messages, teachers can write personalised messages addressed to individual students and include specific data about that student. Messages can be additionally personalised by adding ‘conditional paragraphs’ that only appear to a subset of the filtered students, when specified conditions are met. Together, SRES v2 allows teachers to efficiently collate and process data in a web-based environment to compose and distribute highly personalised feedback and support to students at scale.

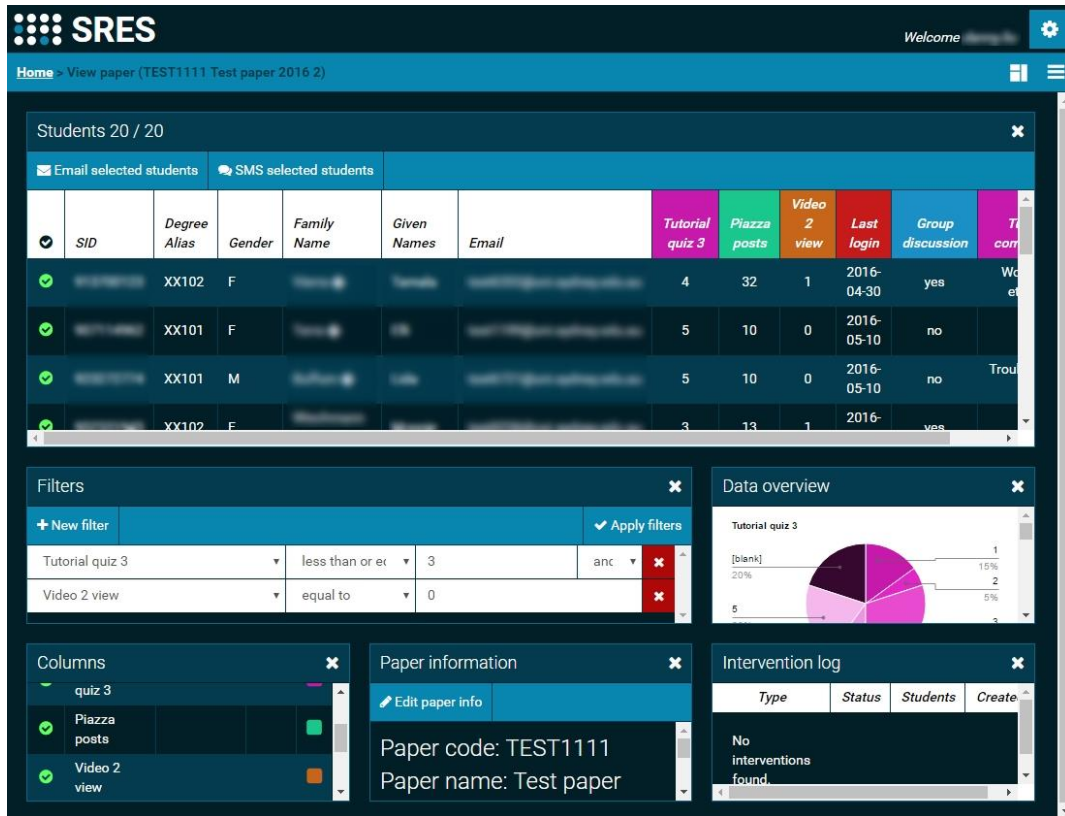


Figure 3. Main interface of SRES v2 showing student list, filters that can be applied to the list, and overview panels.

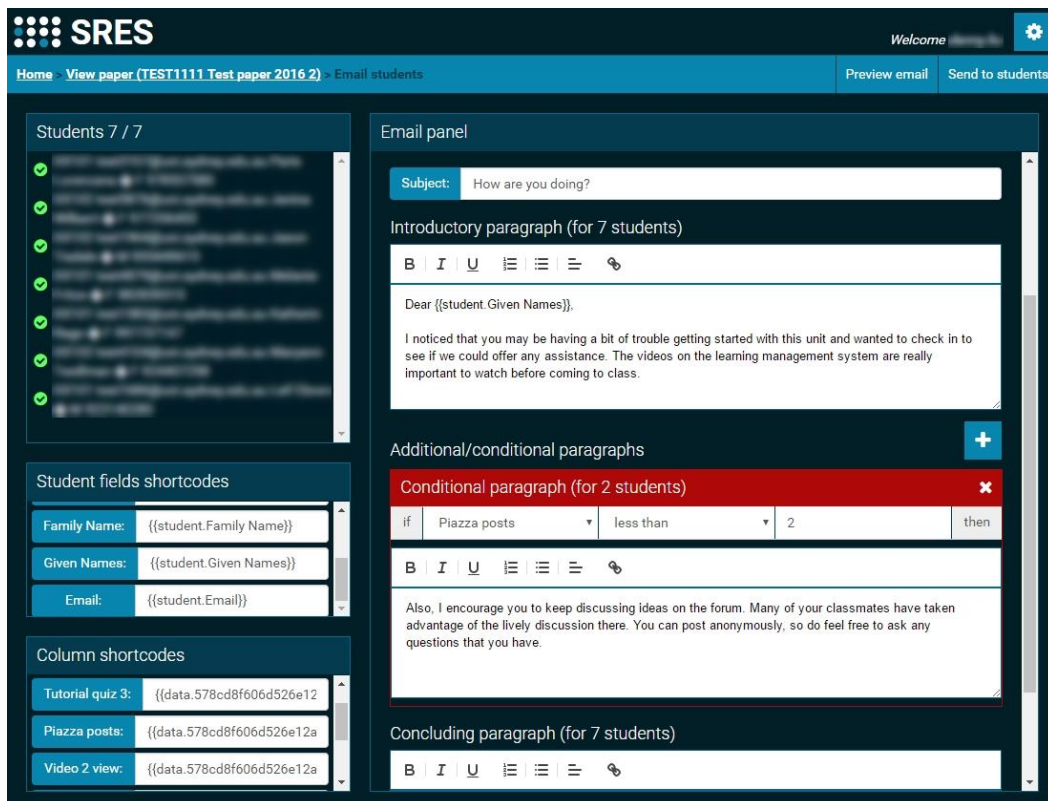


Figure 4. Email composition screen of SRES v2. Messages are fully customisable, and sub-messages can be included to a subset of students.

From inception, we intended SRES v2 to afford cross-institutional collaboration and application, and as such licensed it under the GNU Public License v3. The SRES v2 source code is freely available at <https://github.com/atomsheep/sres>. The similarly-licensed supporting mobile app (leveraging the Phonegap platform for device agnosticism) is available from <https://github.com/atomsheep/sres-app>.

### **Hitting the head winds of institutional change**

The SRES v2 emphasis on ‘bottom-up’ analytics support served us well in terms of teacher buy-in for the project. Working directly with staff at the coalface of classroom and laboratory teaching propelled development of the software forward at an impressive rate, and preliminary feedback from the early demonstration of SRES v2 to teaching staff was overwhelmingly positive. However, the need for ‘top-down’ support is also critical for sustaining educational technology projects, and integrating new technologies into ingrained institutional culture (Lisewski, 2004). Indeed, it has been noted that traditionally educational technologists do not hold positions of leadership in higher education institutions (Kowch, 2005) and as such, their efforts in sustaining developments are often at the mercy of others. With this caveat in mind, support from senior IT and teaching and learning staff for the project was solicited early on.

Just a few weeks shy of the planned pilot of SRES v2 in real classrooms an unanticipated organisational change at the University of Otago meant that the principal developers were deployed elsewhere at short notice. The lack of availability of developer support meant that the classroom pilot studies at Otago could not proceed as planned for semester two. The only option for the project was to continue development and pilot SRES v2 at a partner institution; it was at this point that the real strength of cross-institutional collaboration on an open source project became apparent. From the outset, all use cases, code and project documentation had been shared on Github, and regular Skype meetings between educational technologists and academic developers from all three institutions meant all involved were familiar with the project objectives. With some consulting and handover from the developers at the University of Otago, developers at the University of Auckland, with ongoing support from the original SRES team at the University of Sydney, were able to pick up the system and complete it ready to pilot at the University of Auckland. A pilot study at Auckland is currently underway. The evaluation plan for this is described in brief in the next section.

### **Pilot evaluation plan**

#### *Process evaluation*

The recent implementation of a new LMS environment at the University of Auckland prompted the re-examination of existing teaching and learning processes and services, including new opportunities for evidence based practice in the use of learning analytics data. As a result, adoption of SRES v2 as a pilot for the identification of potential ongoing use in the new LMS, was supported by multiple stakeholders, including the office of the Deputy Vice-Chancellor (Academic), Chief Information Officer, IT Services and teaching staff in three large first-year undergraduate classes.

Evaluation of the development process involved project sign-off, technical set-up, data security, staff training, and development work to adapt SRES v2 to current institutional systems (e.g. Student Information System, authentication services, the new LMS). Obtaining institutional sign off for a grass roots learning technology project is extremely rare in the current centralised environment. Commitment to support the SRES v2 was therefore accepted as positive feedback on both the product and the negotiating skills of the project leader. In addition, the identification of further development opportunities for SRES v2 and the testing of the tool itself are part of the process evaluation.

#### *Product evaluation*

Existing ethics approvals were able to be amended to cover the SRES v2 pilot work focusing on 1) the use of learning analytics to build an evidence base for course design, and 2) the monitoring of students’ engagement with their courses in the LMS to support a first year student experience programme during the semester. From an institutional perspective, the new LMS has resulted in a review of several policies and guidelines on the security and confidentiality of university information as well as the ethical handling of student data. The DVCA’s Office at the University of Auckland has recently formed a working group to advise on the descriptive, diagnostic, predictive and prescriptive analytics requirements of a diverse group of stakeholders with different expectations.

Our current ethics approval allows us to obtain direct feedback from all stakeholders except students. We plan to interview teachers, academic leaders, developers and IT staff to explore the case for the sustained use and wider adoption of SRES v2. If we proceed, it is anticipated that future evaluations will focus on implementation, functionality and ease of use by staff as well as the student experience.

### *In-class evaluation*

At this stage, subject to a successful pilot, we anticipate in-class evaluation of the SRES v2 tool in 2017 at the University of Sydney and possibly the University of Auckland. The current pilot study aims to develop the SRES v2 into an efficient and user-friendly tool.

## **Reflections, next steps and recommendations**

At the time of writing, the pilot at the University of Auckland has just begun. The development team built on an existing relationship to work closely with teaching staff in a large statistics course (1734 students) to pilot SRES v2. The system is being used to send personalised emails to students based on criteria set by, and important to, teaching staff. Each context is unique and thus triggers for action will vary depending on the teaching and learning requirements; SRES v2 has been designed to accommodate this variation. Our experience of the pilot thus far is perhaps best summed up in the following excerpt from an email circulated to all team members from the project leader at the University of Auckland after the first communication was sent to students:

...over 900 personalised emails [were sent] to students. The students [were] assigned to five different teaching streams and received a unique message from four different teachers in the course. All up we spent about 5 hours working through LMS data access, data wrangling, technical issues with our server, bug and enhancement issues for the SRES v2 tool, as well as quality control of the communication. It was a huge learning curve but exciting nonetheless...

Team members from all three Universities responded to the news with encouragement and an eagerness to see the project progress to a point where the impact of SRES v2 on student engagement and learning can be evaluated. A further email from another University of Auckland team member who was present for part of the mail out process, commented on the collaborative nature of the project:

I sat in on part of the session and was impressed by the teamwork, the generous sharing of complementary skills and the powerful logic that made the process a success at the end of the day.

In many ways, this encapsulates the ethos of the SRES v2 project to date. Crucially, the 'generous sharing' of skills and ideas has played a pivotal role, not only in getting SRES v2 development underway in the first place but also in sustaining its development and providing a buffer against the winds of individual institutional change.

Descriptions of collaborative, educational technology initiatives that emphasise what actually works in real-world classrooms are rare. In this paper, we described a multi-institution collaboration that grew from grassroots classroom needs and proved resilient in the face of institutional change. We explained how the initiative came about, how it survived unanticipated change and how it led to the development of a new open-source learning analytics tool for student engagement. Planned future work involves reporting on the first pilot of the tool with teaching staff at one institution, as well as evaluating the impact of SRES v2 on student engagement and learning at partner institutions. The authors welcome new collaborators and invite interested readers to evaluate and extend SRES v2 for themselves.

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