Improving the Quality and Productivity of the Higher Education Sector

Policy and Strategy for Systems-Level Deployment of Learning Analytics

Society for Learning Analytics Research

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[1] https://learn.canvas.net/courses/182/wiki/presentation-schedule

Executive Summary

This discussion paper responds to the **high level of investment** higher education leaders are currently making in data analytics. Australian higher education institutions are devoting considerable resources to better understand the factors that impact student retention and success. The imperative for developing a national learning analytics policy and strategy that **evaluates current international practice and proposes key enabling suggestions** to guide education executives and government officials in future decision making is presented. The need for a more coordinated and systemic approach arises from pressures surrounding **quality assurance and reporting mechanisms**, increased student diversity and mobility, budgetary constraints and establishing a competitive advantage for Australian universities within the global education market. To better assist the higher education sector in building a culture of learning analytics it is necessary to engage key stakeholders in order to identify and address the issues and requirements for developing the technical and policy base for implementation. These concerns include shared data infrastructure; privacy and ethics; and the exemplar predictive models and practices that actively contribute to improved student learning outcomes and success.

In the era of "big data" there are "big opportunities" for the higher education sector. However, there are also significant challenges to overcome before the potential of analytics can be realised.

The analysis of data about users of information systems has been clearly demonstrated to provide an important strategic and competitive advantage in areas such as business, government, and healthcare [8]. Despite significant data collection activity, the education sector has been slow to adopt a strategic and systemic view of analytics. It is envisaged that education systems that do make the transition towards data-informed planning, decision making, and teaching and learning will hold significant competitive and quality advantages over those that do not. However, due to the limited number of broad scale strategic and policy examples available across the education sector, identifying the precise competitive advantages that analytics can bring to the education space is a multifaceted and complex undertaking. This paper aims to examine this short coming and provide a springboard for future discussion and progression, ultimately resulting in the development of a coordinated national learning analytics strategy. To inform this process we undertook:

- an evaluation of the benefits experienced in sectors where analytics deployment was more mature than in education;
- an analysis of provincial, territory, state, and national data collection policies in the education sector;
- a review of universities that are developing analytics strategies; and
- an evaluation of the role of corporate partners in helping universities achieve analytics competence.

The Society for Learning Analytics Research (SoLAR)[2] is a not-for-profit organisation of leading international researchers exploring the impact of big data and analytics on the education sector. Several Australian Universities and researchers have been prominent in SoLAR since its inception. The Office for Learning and Teaching (OLT) engaged with SoLAR in developing this discussion paper in order to advance discussion on moving the education sector towards a coordinated learning data and analytics model. The enabling suggestions proposed here will complement existing plans surrounding government actions in big data by identifying the analytics and data requirements that are unique to the education sector.

Advantages of focusing on a national agenda:

A national learning analytics strategy will provide numerous benefits that can:

- complement existing Australian Government plans in relation to big data by identifying the analytics and data requirements that are unique to the education sector;
- facilitate educational research by identifying learning analytics opportunities and encouraging sector-wide collaboration and data sharing;

[2] http://www.solaresearch.org

- assist the Australian higher education sector to leapfrog international efforts on developing a systemic approach to learning analytics by providing data inventories, standards around data exchange, and articulating data ownership at individual and institutional levels;

- improve the research ethics approval processes at institutions by widening the understanding of meaningful and ethical use of data; and

- improve productivity of Australian education through the use of analytics at all levels of the education sector including recruitment, teaching, learning, retention, administration, and reporting.

This report provides key enabling suggestions for guiding future discussion around a coordinated national learning analytics agenda for Australia:

1. It is recommended that **Australian higher education leaders coordinate a high level learning analytics task force** involving multiple stakeholders from government, higher education, commercial, and ICT sectors to investigate and reduce the current perceived barriers and obstacles for establishing a national analytics policy and strategy.

2. In establishing a learning analytics task force, a core requirement will be to **leverage existing national data and analytics strategies and frameworks.** The development of a national learning analytics strategy will complement existing Australian Government plans in relation to big data by identifying the analytics and data requirements that are unique to the education sector.

3. Privacy and ethics are concerns for individuals, universities, government, and society. **Establishing guidelines for privacy and ethics** will require a transparent and broad ranging conversation between learners, institutions, government, and other stakeholders.

4. It is recommended that Australian higher education leaders place a high priority on developing and promoting a **coordinated leadership program** to build institutional leadership capacity in analytics and the role analytics can play in the contemporary higher education landscape.

5. Systemic capacity for using learning analytics is hampered through the lack of accessibility to skilled professionals and researchers. It is recommended that the Australian higher education sector partner with educational data mining and learning analytics research communities to **develop open and shared analytics curriculum**.

Introduction

Over the past year, across all universities in Australia, in excess of 500,000 people commenced their first year of university study [4]. The number of commencing students in pursuit of a higher education degree has continued to grow over the past decade. This trend is expected to continue. The demand for a higher education degree is driven by the labour requirements associated with the knowledge economy. In this context, higher education is intricately interwoven into the fabric of the knowledge-society [7; 12]. While universities have developed new and more flexible program offerings to reflect societal demands, the contemporary student body brings a far greater diversity of experiences, knowledge, cultural and social backgrounds, mobility, and motivations than previously [10]. Arguably, student diversity and growing mobility have for some time been a challenge for universities. It is only recently through the introduction of alternate and wide-reaching forms of education (e.g. Massive Open Online Courses (MOOCs), and expansion of private and public international programs) that many commentators [5; 9] have begun to question the place and cost of the higher education degree. This is not to presume that education is any less valued. More so, that the distribution and access to education and perceived cost and return are now being examined. With increasing student numbers, diversity in student profiles, greater calls for accountability and quality assurance measures, as well as growing competition for international

students, there is an imperative for developing a more strategic and data-driven mindset in the education sector.

Education needs new ways of thinking, new ways of doing and new ways to evaluate and demonstrate impact.

In Australia, the recently elected Federal Government has given early indications that it sees merit in leveraging the relative maturity of our higher education system to further expand the reach of the sector's international programs [13]. At the same time the Minister has strongly indicated that the value of the sector depends crucially on maintaining the quality and reputation of its offerings [11]. The inherent challenge is to meld what has often been seen to be the mutually exclusive variables of either *quality* or *scale*. The goal for expansion while establishing improvements in quality will rely heavily on extending the use and sophistication of online technologies. While online education has been well adopted in Australian universities, its implementation has centred on delivery of content in lieu of fully leveraging the affordances these technologies bring to learning and teaching [2; 3]. The promise of educational technology to underpin and drive a transformative learning experience will not be delivered through a simple adoption process. This will require educators to revisit and break the historical pedagogical, socio-cultural and economic assumptions that can stifle education practice. Education needs new ways of thinking, new ways of doing and new ways to evaluate and demonstrate impact. The coupling of **new models of pedagogy with learning analytics offers much value to the contemporary education sector**.

The analysis of the data trails evolving from student use of online technologies can provide insight into the learner's progression and therefore the quality of the teaching and implemented curriculum. The analysis of student trace data, recently termed learning analytics, has ignited much innovation and new technologies surrounding adaptive learning and recommender systems for education practice. For example, Knewton[3] founded in 2008 is now one of the most recognised companies in this emergent industry. Knewton is an adaptive learning company that implements real time analyses of student interactions with online learning tasks to continuously modify and adapt future content and learning activities to optimise understanding and progression. Although somewhat lagging behind the commercial sector, the collection and analysis of learner trace data has drawn interest from all levels of the education sector. Teachers, students, faculty, support staff and administrators can all benefit through the application of data to understand what's happening in classrooms and how to improve and optimise learning. As competition for students increases (nationally and internationally), education systems globally are evaluating approaches that enable differentiation amongst their peers. Analytics provide a key area for differentiating the Australian university system by improving learner support through predictive analytics, increasing the productivity of the university system, and guiding strategic investment of limited economic resources. Simply put, Australian universities must access the full potential of learning analytics innovations and technologies to align with and embrace future global education opportunities.

[3] Knewton: http://www.knewton.com/about

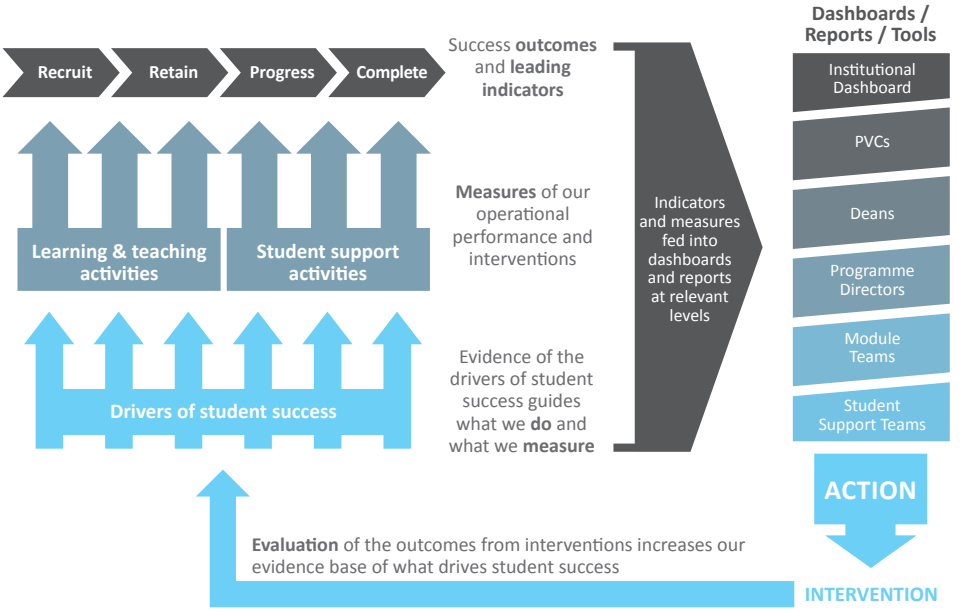
Although research and innovation in learning analytics has rapidly advanced, limited attention has been paid to the larger policy and strategy considerations that influence the adoption and deployment of analytics in educational settings. This lack of strategic deployment and adoption is in part due to the complexity of educational data. While the sector has long collected learner data through state and territory agencies, this data has in a sense been cleansed and removed from any contextual learning parameters. In essence, the messiness of educational data is sorted and categorised according to pre-established questions and quality requirements. As such its application to inform learner, teacher, and institution in more dynamic and agile models has been dramatically restricted.

Figure 1 is taken from the Open University UK's strategy, as presented in the webinar series convened as part of this consultation (Tynan & Buckingham Shum, 2013)[4]. This captures key elements of a systemic institutional strategy.

Figure 1: Analytics will drive action to increase student success

Vision: To use and apply information strategically (through specified indicators) to retain students and progress them to complete their study goals.

(Tynan & Buckingham Shum, 2013)



[4] Belinda Tynan & Simon Buckingham Shum (2013). Designing Systemic Learning Analytics at the Open University. SoLAR Open Course, Strategy & Policy for Systemic Learning

Given the complexity in extracting and interpreting data from multiple pedagogical approaches it is understandable that government and quality assurance agencies have limited the variables to the more transferable, yet obtuse, measures such as attrition, progression, and graduation rates. To date these forms of data and analytics have been used to inform quality assurance processes as well evaluating and benchmarking institutional performance. For instance, international organisations such as the OECD collect and compare performance of learners in the primary and secondary levels. In Australia, organisations such as the Australian Council for Educational Research[5] have extensive experience collecting and analysing data to "improve learning across the life span". In higher education, these forms of data also serve to inform annual rankings (league tables) that essentially produce bragging rights for advancing universities and soul searching for declining universities. Data collection and analytic processes in higher education are commonly far removed from the specific learning context and learner to be able to provide an organisation with any direct actionable recommendations. In contrast the analysis of more fine grained and nuanced data in alternate sectors (e.g. business, health and government), has provided both substantial competitive advantage and a catalyst for innovation and development of new industries [1; 8]. The education system to date has largely failed to make this transition from **data accessible to analytics informed**. Our vision is to place data and analytics tools in the hands of all stakeholders in the education sector, including administrators, faculty, researchers, and learners.

Over the last four years, the Society for Learning Analytics Research (SoLAR) has been a central player in the international learning analytics space. SoLAR has hosted conferences, workshops, Massive Open Online Courses (MOOCs) and summer institutes. In addition, SoLAR has established a dedicated journal, and organised regional events to build analytics knowledge and capacity, facilitate research collaboration, and resource sharing. During these activities, it has become clear that the lack of focus on policy and strategy is hindering the adoption and deployment of learning analytics. More importantly, for researchers, in order for grant-making agencies and foundations to develop research-support programs, the role and value of learning analytics in the education sector needs to be clearly articulated. This discussion paper aims to address the absence of policy and strategy in the deployment of learning analytics. For regions that make effective use of educational data to improve teaching and learning, important competitive advantages exist in the international educational landscape. Numerous case studies are detailed in this discussion paper to give leaders an overview of what it means to provide policy and strategy support for systems that are transitioning to data-intensive operations.

[5] http://www.acer.edu.au

What Are Learning Analytics?

Learning analytics is the collection and analysis of data generated during the learning process in order to improve the quality of both learning and teaching. The field is not a new branch of research per se as it is comprised of, and has evolved from, multiple existing analytic domains and research disciplines such as educational data mining, social network analysis, learning sciences, computer science and many more. While learning analytics is concentrated on the education space (formal and informal learning) there is a vast amount of past research in these closely aligned fields that can be applied to learning analytics to advance its development. However, this is often problematised as a result of disciplinary silos, scepticism and a lack of acceptance and knowledge of analytics. Hence, compared with other sectors, education has a low level of analytics maturity [8]. This finding in the McKinsey report is based on the speed at which education institutions can operate in terms of agility and receptivity to change. As the report notes, all sectors (e.g. government, health) will need to overcome barriers when embracing big data and analytics. For education the low data driven mindset and access to data will further impede progression. **These challenges call for creative solutions and numerous institutions are seeking innovative approaches to re-wire the educational institution analytics mindset.**

A step towards addressing these challenges has been the establishment of a number big data and analytics institutes within higher education[6]:

- *Institute for Big Data Analytics* was launched in July 2013 at Dalhousie University in Canada with the mission to create knowledge and expertise in the field of Big Data Analytics by facilitating fundamental, interdisciplinary and collaborative research, advanced applications, advanced training and partnerships with industry.

- *International Institute for Analytics* is a research firm based in the United States dedicated to defining the path to analytics excellence. Babson College Professor Tom Davenport, who has written extensively about analytics in corporate environments, is a co-founder.

- *Institute for Advanced Analytics* at North Carolina State University has been established with the mission to produce practitioners of analytics who have mastered complex methods and tools for large-scale data modelling.

- *Advanced Analytics Institute* was launched in 2013 at the University of Technology Sydney, Australia that aims to be a world-leading interdisciplinary facility with a focus on innovation in data science and analytics science, evidence-driven decision making research and services in the broad-based analytics areas and domains.

- *Institute for Advanced Analytics* at Bellarmine University, Kentucky, seeks to integrate the liberal arts and data science with interdisciplinary programs in collaboration across the university. The advanced learning options are directly linked to academic programming in Bellarmine's Schools.

- *The Learning Analytics Research Group* at the University of Melbourne was established in mid-2013 in its eLearning Incubator. It is an active network of researchers and postgraduate students pursuing inter-disciplinary research in learning analytics.

> *If sector-wide adoption of learning analytics is to be a future possibility there is a requirement for sector wide commitment to motivate both "heart and the mind" of all stakeholders around the power of analytics to transform education.*

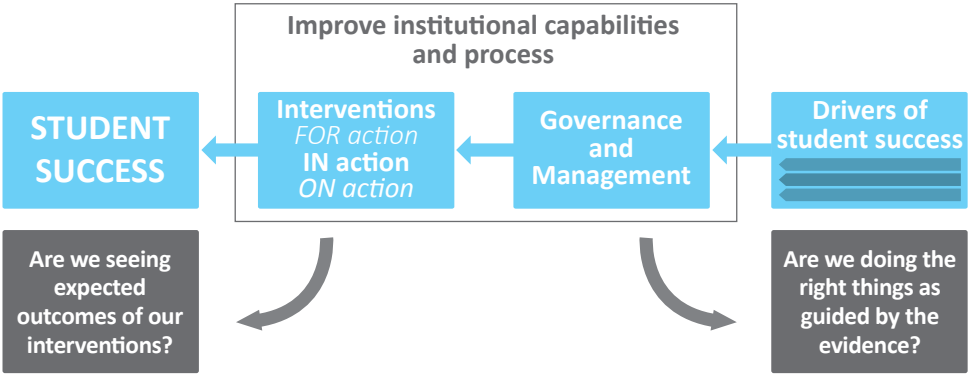
Although these institutes (and many others) hold much promise for research outcomes to inform institutional practice, they remain centred on a perspective of analytics as a technology, as a tool, and as a means to measure. Yet analytics, like any other technological system, is complex and encapsulates the social and cultural domains. If sector-wide adoption of learning analytics is to be a future possibility there is a requirement for sector wide commitment to motivate both "heart and the mind" of all stakeholders around the power of analytics to transform education. To date, the technical solution has been offered with little acknowledgement of the broader complexities that impact organisational change process in higher education.

6 Data science programs are quickly developing in universities globally. A small sample of Masters in Data Science programs can be found here: http://www.mastersindatascience.org/schools/23-great-schools-with-masters-programs-in-data-science

Universities are frequent active partners with software vendors, government agencies, and corporations in researching analytics. Despite the many education start-ups and university and private partnerships associated with analytics, the outcomes of this research and productivity has largely failed to be translated into teaching and learning. As a consequence, university based research institutions that assist and are affiliated with commercial vendors specifically around process and practices to leverage data as a strategic competitive advantage, commonly fail to apply the same level of rigor to their academic practice. This finding was apparent in the various case studies and reviews undertaken for this paper. See for instance the approach from the OU (Tynan & Buckingham Shum, 2013)[7], described in Case #3 and Figure 2. The vast majority of Australian and international universities have embraced some form of learning analytics. As indicated in figure 3, learning analytics is found in small scale or bottom up deployments. In our review of current analytics activity in higher education revealed only a few university systems that had started strategic planning for learning analytics deployment. Many university systems are at the stage of small scale analytics projects to develop recommender

Figure 2: Evaluating impact driving action

The basis for evaluation needs to link interventions to measurable outcomes of student success.
(Tynan & Buckingham Shum, 2013)



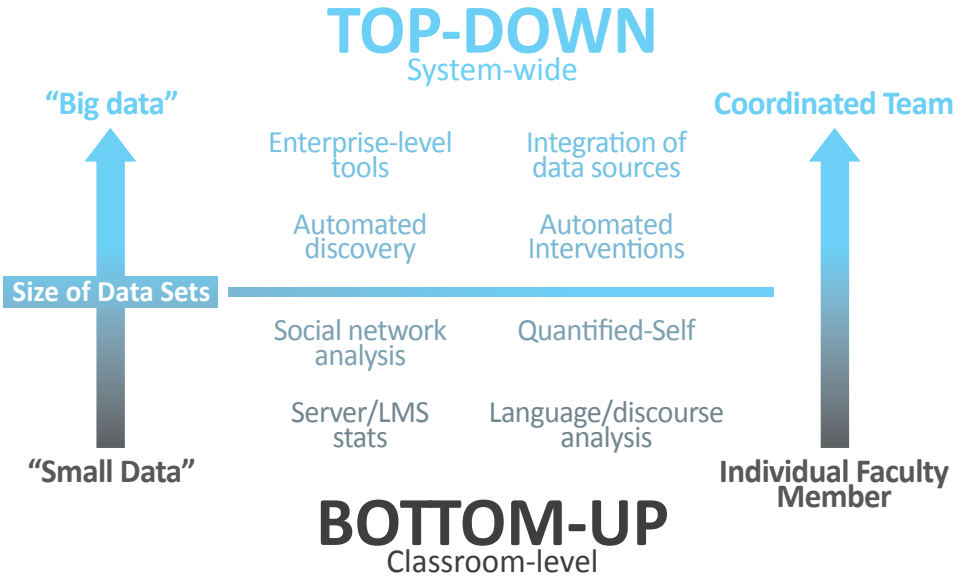
[7] Belinda Tynan & Simon Buckingham Shum (2013). Designing Systemic Learning Analytics at the Open University. SoLAR Open Course, Strategy & policy for Systemic Learning Analytics, 11th Oct 2013. http://people.kmi.open.ac.uk/sbs/2013/10/designing-systemic-analytics-at-the-open-university

systems, predictive models, and attributes and profiles of successful students. We were unable to identify a single system that had developed and implemented an institutional wide learning analytics strategy[8].This lack of enterprise models is also noted by Susan Grajek Vice President of EDUCAUSE in lamenting the lack of broad scale impact that analytics has made to date:

> "We haven't fully figured out how to put analytics to work pervasively throughout higher education to make a difference and resolve our most pressing issues." [6]

The following section introduces national and international case studies to illustrate where institutions have committed to learning analytics at a strategic and systems level.

Figure 3



[8] We are aware of several proprietary and for-profit universities (University of Phoenix, American Public University System) that have developed integrated learning analytics strategies. These systems do not generally make their models available in research literature or in public presentations. Where public presentations are made, such as with APUS, the focus is generally on dashboards and technological deployment, rather than on the process of planning and developing policies. Several emerging universities, such as Western Governors University, have developed advanced learning analytics models but have not yet published their development and planning processes.

Learning Analytics Case Studies

Case #1: University of Michigan (Michigan, USA)

Role of analytics: The University of Michigan is a high research activity public university with an alumni base of more than 500,000. As a state university, it faces pressure to reduce costs and improve educational attainment of its student population. Senior leadership at the University of Michigan targeted learning analytics as an important organisational initiative to assist the university in addressing its current and future challenges.

Strategy: In 2012, the Provost created the Learning Analytics Task Force (LATF), a three year project to advise the university and senior leadership on how to use learning analytics to improve learning and university productivity. The task force has university-wide representation, including faculty from different schools and colleges. Public forums are routinely held for the university community to discuss the range of learning analytics projects being undertaken nationally and internationally as well as hear from experts in analytics[9].

Strategy support: There are three elements of LATF:

1. to explore the information technology environment on campus;
2. to fund the best proposed learning analytics activities and projects; and
3. to review the most effective metrics for learning and teaching.

The learning analytics work is team and mentor based where senior or experienced faculty assist new faculty in developing their analytics capabilities.

Outcomes to date: The task force has provided numerous institutional grants to promising research projects, created a "communication channel" for organisational discussion of learning analytics, and started developing a community support structure to assist researchers, faculty, and others in utilising analytics in teaching and learning. Early recommendations around developing organisational capacity have been implemented. The project has advanced beyond initial organisation stages and is starting to collect feedback to advise on future directions, particularly in relation to the review of metrics for analytics in learning and teaching.

[9] http://www.crlt.umich.edu/slam

Case #2: University of Wisconsin (Wisconsin, USA)

Role of analytics: University of Wisconsin is a large distributed university system with 26 campuses across the state and an extension program. In total, University of Wisconsin serves 180,000 students per year. Learning analytics is being used within the system as a way to help improve the overall quality and effectiveness of the university. Learning analytic tools and processes are being used to help contextualise data to better target learners at risk, and personalise learning in order to give students greater control of their learning process. However, in spite of the early momentum, learning analytics has not diffused broadly throughout the organisation. At present, there are only a small percentage of people on campus involved in learning analytics.

Strategy: The institution is now focusing on building organisational learning analytics capacity by focusing on projects that are deliberate and thoughtful as well as sustainable and scalable. This capacity building also requires time and effort devoted to improving the skills of faculty in working with data and developing organisational strategies to act on analytics. The outcomes from these projects will be collated to develop a systemic perspective on learning analytics.

Strategy support: Staff have commenced development of a learning analytics readiness instrument: Building Organisational Maturity (Kimberly Arnold, University of Wisconsin and Steve Lonn, University of Michigan, Matthew Pistilli, Purdue University). An important aspect of this analytics endeavour involves identifying the right industry partners to assist and fill any organisational gaps. These activities are being undertaken as part of the broader learning analytics strategy development.

Outcomes to date: A key goal of University of Wisconsin's learning analytics activity is to build organisational capacity around the use of data to track and improve teaching and learning. At present, a series of small focused projects have been launched that target important strategy areas and emphasise the use of existing technologies (such as Desire2Learn's Insights – previously called the Student Success System). The learning analytics community consists of 80 members. University leaders indicate that the success of projects to date will ensure successful rollout by year three of the strategy, where successful small projects are moved towards deployment at a larger university scale.

Case #3: Open University UK (OU)

Role of Analytics: The Open University's UK (OU) vision is to "use and apply information strategically (through specified indicators) to retain students and progress them to complete their study goals". OU is looking at micro (short term) and macro (longer term, aggregate) learning analytics as part of their three-year road map for learning analytics deployment. The focus is on three types based on Schön's reflective practitioner model [14]: analytics *for* action (e.g. insight that alerts educators to the likely future needs of students), *in* action (e.g. insight that could improve a student's trajectory mid-course) and *on* action (e.g. retrospective insight for course review and redesign).

Strategy: The university is seeking to develop capability in data science to continually mine data, with active research in several institutes at the intersection of pedagogy and analytics. The goal is to put key data relating to student success in the hands of those in a position to take different kinds of action. The three-year plan for analytics focuses on availability of data, access to data, and gaining insight from data, with all faculties being given the chance to engage in analytics pilot projects.

Strategy support: The OU executive understands the need for a strategic institutional approach to analytics. A university-wide analytics strategy group oversees activity, and funds rapid prototypes with end-users, requiring a clear pipeline for successful innovations to be mainstreamed into operations. The organisation provides post-course reports to faculties, with trained "data wranglers" to help explain the statistics and predictive modelling of pass rates. Real time data is now available to student support teams of 6-8 people including those with expertise in analytics, who can make direct interventions.

Outcomes to date: The work to date has resulted in senior leadership buy-in to analytics, and the development of an organisational ecosystem of analytics pilots, combining commercial products with home-grown code and techniques. Faculties are accustomed to receiving retrospective analytics, but have yet to experience real time analytics. Broader capabilities are still in development (e.g. a unified data warehouse; mainstreaming real time predictive modelling; closing the learning design/analytics loop). The OU's MOOC platform (FutureLearn) provides a parallel development stream, as the OU works with its partners to innovate analytics around these datasets.

Case #4: University of New South Wales (UNSW)

Role of Analytics: The University of New South Wales (UNSW) has a strategic plan to support staff ability to better access and interpret institutional data to improve self-knowledge and services.

Strategy: The development of an institutional data warehouse provided access to key data. However, the creation of user-friendly and flexible tools to analyse and interpret this data – particularly in the area of tracking student achievement and predicting academic risk, was lacking. Hence, the Australian School of Business (ASB), one of nine faculties at UNSW, produced and trialed the Student at Academic Risk Report (SAR) to inform the University's overall approach. The SAR Reports provide timely identification of students at academic risk early in the course allowing for the potential for earlier intervention and advisement.

Strategy Support & Achievements to date: Initial pilot funding supported the identification of 11 academic risk indicators and reports summarising queriable and filterable university data accessed from a number of information systems. Further funding assisted in moving the outcomes to a scalable and automated system. The results of this work encouraged the Student Services Team (SST) to take ownership of the reports, thus embedding advisement from the SAR process into the core business cycle of the Faculty's SST. The Faculty's SST sends approved 'nudge' advising emails to students identified in the reports of nominated courses involved in the pilot. These emails encourage students to increase their level of activity in the course website and identify generic support services. Specially targeted emails (strongly suggesting meeting counsellors/advisors) are sent to high risk students.

Future uses and integration: The CRM integration and SAR pilot in the ASB has provided a scalable solution that can be extended to other faculties throughout UNSW. Additionally, the project has further informed spin-off and related University analytics projects concerning further development of course and program reports and a student facing Moodle LMS activity dashboard project.

Case #5: University of New England (UNE)

Role of Analytics: The University of New England (UNE) is a regional tertiary education institution which serviced approximately 4,500 on-campus students and 16,000 online students in 2012. This distribution is unique compared to other Australian universities, and as such, required an institutional specific approach to revitalising learning, teaching and assessment and improving retention.

Strategy: The Courseware Enhancement Project (CEP) was a twelve month initiative of the university to structurally adjust and establish foundations to support innovation in learning, teaching and assessments. The goal was to work in collaboration with the ten schools to assess and enhance approximately 1500 units offered online. The first phase was a review and assessment of the current state using the Quality Matters (QM) Rubric. QM is a nationally recognised peer review process designed to certify the quality of online course design and online components. The next phase, enhancement, was undertaken collaboratively with work teams from the Learning Innovations Hub (central support) and the disciplinary schools. A review and redevelopment of the Moodle user interface to ensure web standards and to provide an intuitive and flexible platform for academic staff to teach and for students to learn was also undertaken. The final phase, which is currently underway, is to capture and identify the long term business requirements and data sources to inform the development of a courseware workflow management system. This includes the collection and collation of all learning analytics activities currently underway at the unit, course and school levels to enable a systemic implementation university wide.

Outcomes to date: The UNE Early Alert Program (EAP) commenced in 2010 as a means of identifying students at risk of disengaging from studies, a known contributing factor to retention rates. This program developed the Automated Wellness Engine (AWE) to analyse student information using 34 triggers with varying weights, which the student support team used to contact the 200 most at risk students.

Case #6: Queensland University of Technology (QUT)

Role of analytics: Queensland University of Technology (QUT) is a multi-campus large metropolitan university with approximately 45,000 students. The two major current areas of analytics deployment are in course performance reporting and the monitoring of early intervention activities related to student learning engagement. In the latter, data from multiple sources is combined to identify students who are predicted to be at-risk of disengaging from their studies. The intervention is a tailored, timely and purposeful phone call from an experienced student to offer advice and support. Indicators used are behavioural and cognitive. The aim is to foster a sense of belonging, promote student activities that lead to successful learning, including seeking out and using resources and life and learning support services.

Strategy: QUT has a large scale project to build organisational analytics capacity including learning analytics. In terms of curriculum, the goals are to capture data to enable students and staff to visualise the progressive attainment of knowledge and skills building to graduate outcomes. In the monitoring and intervention program, the strategy is focused on improving data integration, developing accurate predictive models and timely real-time analysis of students at-risk of disengaging and earlier monitoring of the affective characteristics of engagement. Other considerations include: information design and communication, producing actionable knowledge, and ensuring capacity for acting on the information provided through the analytics engine. QUT is seeking to establish a sustainable and scalable analytics program through the planned growth of aspects including a university-wide approach, data management skills, statistical expertise, institutional knowledge, scalable technologies and service partnerships.

Strategy support: QUT has completed a conceptualisation phase intended to rapidly consolidate in-house capacity at a hands-on level. Development of a range of prototypes using readily available, low-cost mathematics, data mining and visualisation software provides the institution with longer term scalable and sustainable support in analytics. Internal and external partnerships are critical to achieve the aforementioned strategy.

Outcomes: The early intervention program has resulted in significant improvements in retention for those students who have been successfully contacted. Both the course reporting and the monitoring programs are university-wide.

Case #7: University of Technology Sydney (UTS)

Role of analytics: UTS is a dynamic and innovative university in central Sydney with over 37,000 students and more than 3,000 staff. One of Australia's leading universities of technology, UTS has a distinct model of learning, strong research performance and a leading reputation for engagement with industry and the professions. UTS has embarked on an holistic approach to data capability, covering the broad areas of research data, corporate data and learning analytics. Analytics is viewed as being essential to achieving the university's vision to be a world-leading university of technology.

Strategy: UTS is rolling out an institution wide strategy, addressing the need to be a data intensive university. This strategy crosses over research, and teaching and learning portfolios, as well as exploration of other areas of institutional support such as the infrastructure, workforce planning, technology, policy and process issues. While embryonic, this strategy is supported at the senior level of the university and growing in momentum.

Strategy support: UTS has a central business intelligence portal providing management information to UTS decision makers. This is being supplemented by the development of specific datamarts, such as one for student data. Digital and data literacy projects are underway to develop both student and staff capability. Learning analytics pilot programs have mined data from existing systems which are then deployed through the Advanced Analytics Institute at UTS – a specialist research institute with an international reputation for data and analytics science.

Outcomes to date: UTS has been engaged in a variety of learning analytics projects to assess scale and impact. UTS have used analytics to identify why students continue to fail subjects or why there are low pass rates in particular subjects. These findings have led to interventions around the order in which subjects were taken in particular courses. The early identification of students at risk of failure or attrition led to a prioritisation of contact made with students in their first year of study to offer support tools and mechanisms. Additionally, UTS has piloted a student dashboard, measuring effort and engagement, which then provides a 'help yourself' toolkit/front end.

Case #8: *Swinburne University of Technology (Swinburne)*

Role of analytics: The Swinburne Connect program is primarily designed as a retention project. Swinburne Connect is an outbound proactive campaign initially piloted in 2012 in partnership with its key recruitment partner, Hobsons Asia Pacific[10]. The campaign was aimed at students identified as being "at risk of dropping out" and was focused on commencing higher education students. The program is an engagement strategy that uses outbound phone calls to communicate with the identified cohort, identify any potential issues and actively refer students to the relevant service or support. There is follow up communication to all students who were actively referred to the service, as well as the discussion of any further issues. Students are mainly identified as being "at risk" by using a set of demographic and behavioural triggers.

Strategy: Swinburne University of Technology recognised the need to improve retention rates for students, especially commencing students. Discussions with internal stakeholders demonstrated strong support and engagement across the organisation. The key recruitment partner, Hobsons, was able to assist with a solution for retention activity. The implemented project provided an opportunity to rapidly connect students to the myriad of support services available across the University in a timely manner.

Strategy support: Swinburne Connect includes demographic and behavioural data as triggers to populate the database for initial follow-up. While this not an easy task due to the complexity of the adopted Student Management System, assistance from knowledgeable stakeholders provided key information into the service database. The initial pilot study was relatively small scale with a cap of 5000 student contacts. Reporting functionality has been developed to provide baseline metrics, service referrals and indicators of stressors for students. These are provided to faculties and senior management, and have been included in reports to council and in high-level planning for the university.

Outcomes to date: The pilot had an overwhelmingly positive response from the students contacted. The pilot served to build awareness of support services available to students across the University service areas as well as within each Faculty. The pilot consisted of commencing students that were communicated with and those students who did not engage. The results from the pilot indicate that the retention rate of the engaged students was much higher than the non-engaged peers. Overall the pilot has proven to be of great value in engaging with commencing student cohort, identifying issues and creating awareness of appropriate support services. Based on the early success indicators of the pilot study the project has been extended and supported by Swinburne's management for a further three years.

[10] http://www.hobsons.com/apac

Case #9: University of South Australia (UniSA)

Role of analytics: The University of South Australia is a young, progressive university with in excess of 30,000 students committed to excellence in research, teaching and student experience. The university is noted for its outreach to non-traditional university students, and boasts a culturally, linguistically and socio-economically diverse student population. Learning analytics have been adopted in order to provide an empirical base for improving student success and retention outcomes.

Strategy: In 2010 the University of South Australia's Senior Management Group approved a pilot of a program aimed at improving student success and retention outcomes. The program, named Enhancing Student Academic Potential (ESAP), sought to identify students at risk of academic failure or attrition, and to counsel these students regarding study and pastoral support options available throughout the university. These early support interventions were carried out via targeted phone call 'campaigns' conducted by a team of trained senior students. ESAP's current focus on first-year students is predicated on institutional evidence that commencing first-year, undergraduate students are more vulnerable to attrition and report lower levels of student success than continuing students. The institution recognised that ESAP's strength lay in an empirical approach to analysing student performance, and effectively identifying poor performance. Accordingly, the development of the ESAP program has recently been enhanced by the pursuit of an expanded data analytics agenda. A steering committee was established in late 2012 to provide oversight of the project, with a team of staff deployed specifically to undertake development of analytic reports and models associated with learning and teaching more broadly. Particular operational focus has been on the development of predictive algorithms of student risk based on data-mining techniques and visually communicating this risk to key stakeholders via an analytics dashboard.

Strategy Support: The University of South Australia's data analytics project is overseen by a cross-institutional steering committee, and enacted by staff from multiple business areas within the institution. The ESAP program is part of a broader research agenda that continually evaluates the process and outcomes to ensure it is resource optimised and empirically grounded. A university-wide strategy is underway that targets broader adoption and development of easily interpretable visualisations to facilitate meaningful action.

Outcomes to date: Early iterations of risk identification through learning analytics have been used to inform the development of interventions and support strategies in the university's main outreach program, ESAP. The results of the program have informed the development of predictive metrics and models for the institution. ESAP interventions in the first half of 2013 were applied to courses with total enrolments of 3354. 730 students enrolled in these courses were identified as at risk, and 549 were contacted. Of students contacted, 66% passed the course with an average GPA of 4.29. In contrast, 52% of at-risk students not contacted passed the course, with an average GPA of 3.14. The expansion of the program is in development and the release of the teaching dashboard has advanced with early prototypes currently in trial.

Case #10: The University of Queensland (UQ)

Role of Analytics: The University of Queensland is a research intensive university with four primary campuses that host 46,860 students. UQ is a public university among the Group of Eight (Go8) research intensive, comprehensive Australian universities with general and professional education programs. The senior leadership recognised the importance of applying evidence-based data driven methods of learning analytics, to transform the student experience. As a result the UQ Learning Analytics Initiative was launched.

Strategy: UQ has approached learning analytics systematically by first understanding new technologies and ways of collecting and using digital data. Organisational structures were rearranged appointing an Executive Director for Innovation and Analytics, and creating a professorial chair in learning analytics with a team to drive research in this area. Finally an approach was developed that at the institutional level looks to assess and integrate learning data into a programmatically accessible academic warehouse. Two categories of data are represented, one describing data relevant to the individual learner, and a second reflecting institutional data on program and curriculum performance. The learner data is itself divided into a set focused on research on learning and a set relevant to real-time actionable data for learner decision-making.

Strategic Support: The institution is focusing initially on three aspects of analytics: understanding the implications of big data from learning through its participation in the edX project[11]; a second institutional focus on student retention through an analysis of the data collected among its enterprise systems and their application to identify and intervene among students at risk; and finally building research capacity through the establishment of a Chair for Learning Analytics, around which an inter-disciplinary research program has begun.

Outcomes to date: In 2008 the Vice Chancellor and Deputy Vice Chancellor Academic founded the Centre for Educational Innovation and Technology to experiment with emerging digital technologies used by learners across programs. From this tool and course level experimentation a wider institution-level strategic commitment was expressed as UQ became a co-founding member of SoLAR. An Executive Director of Innovation & Analytics was created in early 2013 to lead and coordinate learning analytic initiatives campus-wide. The 2014 Strategic Plan affirms UQ's commitment to developing its analytics capacity at scale through the design and delivery of UQx (edX hosted) MOOCs. Research to track learning design patterns through instrumentation of browser-based interfaces is being coupled with data collection on user interaction with content, co-learners, and feedback. A learning pathways tool tracks students daily accomplishments highlighting what the learner needs to know, and what the learner needs to do associated with each learning design pattern. This is intended to provide visually informative actionable views of student behaviour to support informed decision-making. Organisational work to build an academic data repository will provide the basis for an enterprise-wide change management framework bringing data to life by visualisation, predictive modelling, and learner shaped recommendations.

[11] https://www.edx.org

Lessons learned from case studies

These case studies reveal similar problems and challenges that educational institutions face regarding the development and deployment of learning analytics policies and strategies. Early successes from these projects can therefore be used to guide activity in other systems. The case studies centre on getting actionable data into the hands of those who need it most and are subsequently capable to make any necessary curriculum, process, or system changes. The case studies also highlight the capabilities and skills shortage and access to knowledgeable people who are able to link pedagogy and analytics. This deficit needs to be addressed and the inclusion of a growing number of data analytics courses will help to build capacity. Regardless, there are many advantages in undertaking a more collaborative approach to address this skills deficit as indicated by several universities that adopted a team-based approach to increasing analytics capabilities. In this context the establishment and coordination of a high level task force with multiple stakeholders can enable the development of strategy and processes to create the necessary infrastructure for shared data and learning analytics expertise and resources.

As with most endeavours, another critical success factor in these case studies is informed leadership. It is vital that the key pedagogical questions are the drivers rather than tools or perceived technical limitations. There is a space for Australian higher education leaders to assist in forming a task force or working group to clearly articulate the educational issues that are germane to the Australian context. Vendors are growing in the learning analytics field and university leaders often face vendor-provided solutions when not all the questions or requirements have been clearly articulated. Learning analytics involves making meaningful use of the data in an educational perspective.

The barriers of access to data are still present in addition to unresolved privacy and ethics concerns. Individuals at different universities are continuing to experience the same data access barriers as well as getting ethics committees to understand how data trails and processes have changed and how to assist in widening the experience. Big data and ethical and privacy concerns are becoming more important in a digital age. The Australian education sector needs to be proactive in raising these conversations in order to develop a national approach. This will enable improved ethics approval processes at institutions by widening the understanding of meaningful and ethical use of data.

Different institutions appear to be addressing similar concerns that include the development of data warehouses. The Australian higher education sector can leapfrog international efforts through developing a systemic approach to learning analytics by providing data inventories, standards around data exchange, and articulating data ownership at individual and institutional levels. As with most new initiatives, funding is required to enable institutions to undertake an iterative approach. Universities need to learn from each other in order to collectively improve productivity of the Australian higher education sector.

Creating A Unified Data Strategy

In order for Australia to increase the quality and competitiveness of its higher education sector, substantial work needs to be done around access to data and the quality and granularity of the accessible data. This includes:

1. Conducting a national higher education data inventory and identifying gaps in data collection that needs to be addressed through additional data collection activity and instruments.

2. Creating centralised databases that are accessible to universities, decision makers and researchers.

3. Addressing stakeholder concerns around educational data of learners including privacy and ethics. For instance, questions such as who owns the data (learner, institution, or government agencies involved in collection?) need to be addressed.

The primary and secondary education systems have progressed beyond higher education in terms of how data is collected, analysed and shared. Often this data is collected for regional, national, and international comparisons (i.e. PISA). The process of developing a learning

analytics strategy can benefit from evaluating the successes and challenges of primary and secondary education sector data initiatives such as Data Quality Campaign[12] and InBloom[13]. New education technology start-ups such as Learning Locker[14] adopt a learner-centric view of educational data. Where this approach is used, consideration must be given to the possible benefits for enabling the sharing of certain types of data across universities. Significant technical and legal challenges exist in defining how learner-owned data is defined, stored, and accessed by the university.

Current examples of data initiatives are not limited to learner-generated data. Projects such as the LearningRegistry[15] also focus on data around learning content. In the context of learning analytics, content metadata is necessary in order to provide scalable instances of personal and adaptive learning. It is only through an understanding of the pedagogical context within which the data is generated that patterns and trends can be interpreted and developed into scalable actions. Here, the rapidly advancing area of semantic technologies can assist in developing the necessary heuristics and ontologies to complement and extend what is currently largely basic quantitative analytics.

Skills and capabilities shortage

The implementation of more sophisticated forms of analytics such as machine learning and natural language processing requires high-level knowledge. Yet even within the quantitative analytics domain there is an identified skills shortage within education related to individuals that have the necessary experience and talent to undertake data mining, processing, analysis and interpretation. Data analysts, enterprise architects and researchers with the necessary knowledge and skills to interpret messy data into action and targets, are in short supply. Given the global demand for these positions, resource and skill sharing across the education sector is an asset that is presently under-utilised. As institutions increase collaborations into joint program offerings there will be a necessary requirement to share student and learning content data.

This skills shortage in part explains the lack of analytic exemplars that have moved from research projects to enterprise solutions. In this context, it is not surprising that there is a need and demand for external commercial vendors to step into this space and assist universities in their analytics strategy. Education technology start-ups, social media or established technology and analytics companies are quickly positioning themselves around data acquisition, analysis and provision of IT infrastructure. The analogy that data is "the new oil" is well taken. However, frequently the solutions are not quick fixes. As noted above, analytics requires

[12] http://www.dataqualitycampaign.org

[13] https://www.inbloom.org

[14] http://www.learninglocker.net

[15] http://learningregistry.org

an institutional wide strategy, a focus on building analytics mindsets and capabilities, and adoption process with strong leadership and well-resourced staff who are committed to evidence based decision making. As identified in the various case studies, a barrier to institution-wide adoption of analytics pertains to the lack of a common understanding of analytics in general and the definitions that are associated with user and content generated data. This process for implementation and acceptance can be advanced through the use of a "universal exchange language" that unifies and assists data sharing, collection and analysis not only within the organisation but across all levels of the sector.

Future directions and challenges

Higher education faces many technical and leadership challenges in the adoption of learning analytics. A critical deficit, once a vision and strategy has been established, is the limited capacity of universities in implementing analytics strategies [15]. This capacity shortcoming is evident in many levels of the university, including administration, teaching, and IT. In our analysis of early-mover universities, each one reported the need for building technical capacity for analytics as well as developing a culture or mindset of analytics. This requires multi-year planning as well as resource support and policy integration.

As analytics involve multiple departments, it is critical that senior leadership is supporting and driving analytics activity. University of Wisconsin noted three critical challenges in their analytics strategy:

- Identifying scalable options including pedagogical, technical and human resource skills and capacity

- Establishing analytics sustainability – alignment with institutional vision and goals and filtering analytics into the core of organisation's performance indicators and management process

- Diversity: are the right things being assessed and are the right people involved?

It is recommended that these considerations are incorporated into national analytics work groups and strategy planning sessions. Finally, several universities have turned to corporate partners to assist in deploying learning analytics. Organisations such as IBM, SAS and Civitas Learning can play a role in addressing organisational capacity challenges regarding analytics. However, this role must be well integrated into the culture of the organisation to avoid the procurement of an expensive and under-utilised analytics infrastructure.

Moving towards a national learning analytics strategy

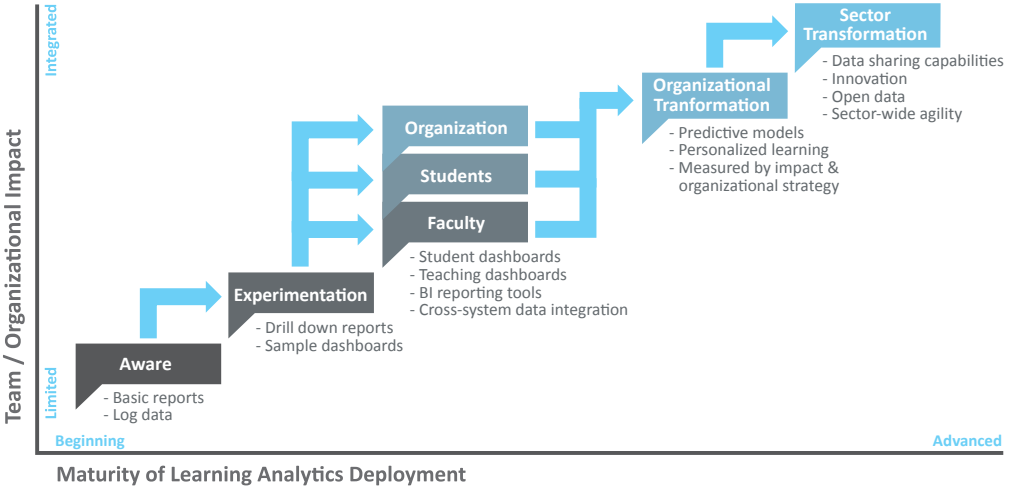
The pressures associated with the increases in student participation, expansion in the international market and demand for greater accountability and efficiencies can have a detrimental impact on the quality of Australia's education system. Learning analytics has the potential to dramatically re-shape current education offerings to provide improved quality and productivity while fuelling innovation and new industries. Achieving these goals requires a coordinated and national strategy. As the integration of digital technologies continues in the education sector there is a danger that the Australian higher education sector loses pace with the parallel employment of the processes and infrastructure necessary for data capture and analysis. However, the sector must be mindful this is not simply a technical problem rapidly resolved with the installation of tools and technologies. Learning analytics includes technical, cultural and social aspects and as such any shift in organisational acceptance must also embrace the unique challenges these elements bring.

Learning analytics includes technical, cultural and social aspects and as such any shift in organisational acceptance must also embrace the unique challenges these elements bring.

The review undertaken for this discussion paper provides some insight into the vast potential of learning analytics for driving change in higher education and promoting a high quality learning experience for all students. However, the review also reveals the challenges that must be

addressed in order for analytics to move from small pockets of innovation and excellence to a transformative force impacting and driving evidence based decision making across all facets of the education sector. Figure 4 details stages of learning analytics sophistication, including growing maturity and systems level deployment.

Figure 4: Learning Analytics Sophistication Model



Rationale

As noted recently by the CEO of IBM, "data is the foundation for competition and advantage in the future"[16]. While these comments were addressed toward the business sector, the message of data and analytics as a means of improving organisational and systemic performance is one that the education sector needs to recognise as important. The rationale of a national policy and strategy document on learning analytics is to enhance the Australian education sector's quality and international competiveness by improving sector wide productivity, quality, and learner success through leveraging data generated at all levels of the education system.

Conclusion and enabling suggestions:

This report provides key enabling suggestions for guiding future discussion around a coordinated national learning analytics agenda for Australia. In order to place the Australian Higher Education sector in a position primed for leveraging and capitalising on the productivity and quality gains analytics can bring to the sector we recommend the following actions:

1. Analytics can drive substantial gains in productivity. Within the educational context this relates to both student learning gains, and also improvements in program delivery through curriculum efficiencies and enhanced quality. It is recommended that Australian higher education leaders **coordinate a high level learning analytics task force** involving multiple stakeholders from government, higher education, commercial, and ICT sectors to investigate and dilute the current perceived barriers and obstacles for establishing a national analytics policy and strategy. In so doing, the strategic task force must establish the requirements surrounding shared data services. This entails developing strategy and processes for **enabling data to be shared across institutions** and creating the necessary infrastructure and records for student, faculty, and institutions. Data models from the health care sector can provide guidance in addressing these data challenges.

2. In establishing the task force a core requirement will be to **leverage existing national data and analytics strategies and frameworks.** The development of a national learning analytics strategy will complement existing Australian Government plans in relation to big data by identifying the analytics and data requirements that are unique to the education sector. It is recommended that a "data inventory" be undertaken to assess the various data collection activities prominent by Australian universities and identify missing data/ collection gaps. Access to the growing number of data inventories can enable institutions to undertake greater experimentation to advance research into learning, develop new technologies and analytic processes, as well as identify redundancies and inefficiencies to improve performance.

[16] https://www.youtube.com/watch?v=ZInIDdBuSqo

3. Privacy and ethics are concerns for individuals, universities, government, and society. The legal system often lags in providing timely guidance around privacy and ethics of digital data. As a result, universities face ambiguity in appropriate uses of learning analytics. Effective applications of learning analytics require the integration of data from multiple databases. Establishing **guidelines for privacy and ethics** will require a transparent and broad ranging conversation between learners, faculty, institutions, government, and other stakeholders.

4. To move a university and the higher education sector as a whole from **data-accessible to analytics-informed** requires strong leadership and awareness to instil a coherent vision and strategy and to navigate the complexities and resistance to change that are often pervasive in education. The Australian higher education sector needs to provide the necessary programs to develop institutional and sector leadership skills and analytics awareness in order to promote and facilitate adoption of an analytics mind-set. It is recommended that the **university leaders place a high priority on developing and promoting a coordinated leadership program** to build institutional leadership capacity in analytics and the role analytics can play in the contemporary higher education landscape.

5. A growing capabilities and skills shortage, which has been well documented in other sectors such as healthcare, business, and government, is a confronting challenge for higher education as it moves toward an analytics-informed framework. It is recommended that the Australian higher education sector partner with educational data mining and learning analytics research communities to **develop open and shared analytics curriculum**. Organisations such as IEDMS and SoLAR can provide curricular resources and contribute to the development of skills across the higher education sector. As IEDMS and SoLAR are global organisations, faculty, leaders, and staff will have access to current and relevant learning materials and academic programs. It is recommended that these analytics programs move beyond teaching only data analytics techniques and focus developing skills for holistic sensemaking and gaining actionable insights through analytics.

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Acronyms

ACER	Australian Council for Educational Research
ICT	Information and Communication Technologies
IEDMS	International Educational Data Mining Society
OLT	Office for Learning and Teaching
Michigan	University of Michigan
MOOCs	Massive Open Online Courses
QUT	Queensland University of Technology
SoLAR	Society for Learning Analytics Research
Swinburne	Swinburne University of Technology
UNE	University of New England
UNSW	University of New South Wales
UQ	University of Queensland
UniSA	University of South Australia
UTS	University of Technology Sydney
UMelb	University of Melbourne
Wisconsin	University of Wisconsin

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