The Connected University: Connectedness Learning Across a Lifetime

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This is a draft chapter / article. The final version will be available in Higher Education and the Future of Graduate Employability: A Connectedness Learning Approach edited by Ruth Bridgstock and Neil Tippett, forthcoming 2019, Edward Elgar Publishing Ltd

Author Note

We gratefully acknowledge support from the Australian Government Office for Learning and Teaching (OLT) and Graduate Careers Australia (GCA) in completing this work. The views in this paper do not necessarily reflect the views of either body.

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Abstract

Despite being proposed as a method for implementing networked learning approaches to learning over a lifetime, at present connectedness learning is usually implemented by close knit teams, and inside one institution. In this chapter we take a step back, considering what might be required to implement it at scale and over a lifetime. The importance of this agenda is highlighted with reference to the changing nature of work; as modern technologies disrupt a wide range of job roles traditionally considered safe it is essential that universities provide portable data that will help our students to demonstrate competencies, claim prior learning and navigate to new opportunities. We use the ongoing work at one Australian institution to guide our perspective, drawing upon the lessons learned in two ongoing projects to make a series of recommendations that we believe will help scale up connectedness learning across an individual's entire lifetime of learning.

Keywords: Connectedness Learning; Lifelong Learning; Employability; Data Interoperability; Personal Data Ownership

Learning Across a Lifetime

Learning happens across a lifetime. In a constant process of personal growth, individuals connect across a wide variety of spaces and in markedly different contexts: learning from their peers in classes, developing new skills when dealing with groups, applying skills learned in extracurricular activities to new contexts, etc. As they gain confidence, those same individuals start to mentor, teach, and instruct other people in their network. Sometimes they decide to return to formal learning opportunities, sometimes not. This process of learning continues throughout a lifetime, not just during a finite period of formal education at the start of a person's career.

This means that an individual will experience a wide array of learning experiences throughout their lifetime, connecting with a broad cross-section of people and systems, both formal and informal. As was discussed at the beginning of this volume by Bridgstock and Tippett (2019), the last two decades have seen an increasing recognition of the importance of helping our students to develop the skills, mindsets and capabilities to connect; with each other, with academia, and with people who can help them to grow a professional identity. Multiple theories have formalised this need, described approaches for achieving it, and discussed its benefits. And yet it is difficult to find an example of a university that has achieved any form of connectedness learning at scale. We must start to ask why.

In this chapter we will step back, moving away from a consideration of individual cases of practice designed to encourage connectedness learning, to consider instead how the enabling strategies for achieving connectedness learning might be facilitated by a university's digital infrastructure. Reducing institutional barriers to connectedness is not an easy feat to achieve. Here, we will start to move beyond specific teams and individual universities and ask what type of information ecology (Davenport, 1997) will help to facilitate connectedness learning across a lifetime of learning.

We start with a brief examination of workforce disruption and transition to illustrate why lifelong connected learning is more important than ever.

Employability in an Age of Workforce Transition

The modern conceptualisation of employment is rapidly shifting. While our parents planned to work for the same company for life, our children can expect to change career many times (CEDA, 2015). As a range of social, economic and digital influences start to impact upon the workforce, few people can expect to stay in one career throughout their lifetime, with estimates emerging that the current generation of school leavers can expect to have around 17 jobs across 5 careers in their lifetime (McPherson, 2017).

This problem also affects employers. Many professions have problems with retaining a skilled workforce; people increasingly tend to move and transition to new opportunities if they find themselves bored or disenfranchised. For this reason we increasingly see data entering into the workforce, for recruitment, the calculation of KPIs and other challenges being faced by Human Resources (HR) departments. Fields such as *HR Analytics* are increasingly claimed to help with recruitment processes and longer term professional development of staff (Bersin, 2018). However, such changes in HR practices can bring both invasions of privacy, and risks of poor automated generalisations about the capability of an individual. For instance, are our basic metrics and assumptions about performance correct? If they are not then the use of analytics and automated reporting will only serve to institutionalise bias and poor practice.

How does this play out in connectedness learning? The true value of connectivity has not traditionally been well recognised in the workforce. People use Personal Learning Networks

(PLNs) (Richardson and Mancabelli, 2011) and social relationships to ask questions and seek information. These informal conversations lead to the sharing of information via weak ties (Granovetter, 1973), and are facilitated by supercooperators (Nowak and Highfield, 2011), who are key to the effective transmission of information in an organisation. Often an individual's essential dissemination and linkage role is not apparent until they move on and communication issues arise. However, few performance metrics reward such behaviour, and so recognition of these informal links is generally *ad hoc*. How might we start to surface some of these important characteristics in the metrics that are increasingly being used?

One of the fields that holds the most promise for developing new metrics of these complex competencies is Learning Analytics (LA), which has largely arisen from the field of Higher Education (HE) and so provides a natural avenue through which HE might start to influence these developments in the workforce. Perhaps there is an opportunity to start measuring behaviours that we actually value in the workforce, instead of the more common scenario where institutions reorient their KPIs to value the things that they can measure (Kitto, Buckingham Shum and Gibson, 2018).

Learning Analytics for a Lifetime of Connectedness

While HE was slow to adopt analytics when compared with other sectors, there is growing recognition of the importance of different kinds of Learning Analytics (LA) for helping to improve the quality of education (Siemens, Dawson and Lynch, 2013). However, institutional adoption has tended to be sporadic at best (Colvin, Rogers, Wade, Dawson, Gašević, Buckingham Shum, and Fisher, 2015) for a wide range of reasons, including: surprisingly low data literacy in many parts of the academic workforce; poor practices in data warehousing making it difficult to access necessary data; siloed policies and practices etc. A number of new policy frameworks, leadership models and organisational structures have started to emerge in an attempt to address these problems (Tsai, Moreno-Marcos, Tammets, Kollom and Gašević, 2018; Buckingham Shum and McKay, 2018; Dawson, Poquet, Colvin, Rogers, Pardo and Gasevic, 2018).

One branch of LA, Social Learning Analytics (Buckingham Shum and Ferguson, 2012) could help to resolve problems associated with finding metrics of connectivity and contribution. Social Learning Analytics have been intensively studied over a number of years, with interesting tools starting to emerge from this research (Chen, Chang, Ouyang and Zhou, 2018). Sensemaking tools that help people to think about their place in a network, and how they might leverage this to develop their careers seem to be just around the corner. Other avenues of work include developing student facing LA solutions that will help people to build other 21st century skills that prepare them for lifelong learning in a complex and uncertain world (Buckingham Shum and Crick, 2016). Skills like: critical thinking, creativity, collaboration, metacognition, and motivation are increasingly valued across all curricula (Lai & Viering, 2012) and LA is rising to the challenge of finding innovative ways to use data to encourage their development.

However, universities need to do more than support our students in developing a rich portfolio of attributes and skills; we also need to help them to *demonstrate* those attributes, in a manner that employers can understand and interpret. This in turn requires that students be able to make sense of their own learning records and digital traces, understanding what they are doing (and why) to the extent that they can use the artefacts of their learning as evidence of their capabilities. It is not just universities that need to map course learning outcomes to assessment tasks; our students also need to understand how their various subjects connect, and how what they are doing will connect them with their chosen profession. However, a lack of access to data means that LA is rarely applied at a whole of course level, let alone across a lifetime.

Where is the data?

In a lifetime model of learning, we immediately come across a problem that many universities have until now avoided: learning happens everywhere, at any time. People continuously plan for the future, upgrade their skills, interact with others who have different attitudes, beliefs, skills etc., and encounter new sources of knowledge (both online and in the real world). Throughout a lifetime it is reasonable to expect that one person will interface with many different educational systems (e.g. K-12, higher education, and continuing professional development). Workforce disruption implies that university graduates will increasingly enter the workforce for a period and then return to formal education when they decide to upskill or retrain in a new profession. While participating in each of these different educational systems throughout their lifetimes, our students will leave digital traces in a large number of different IT systems: Student Information Systems (SIS); Learning Management Systems (LMS); Social Media; MOOC platforms; Human Resource Systems; and ePortfolios, among many others.

The digital traces that are relied upon for analytics by various communities are not connected at all. They are siloed in various different IT systems and organisational structures. Any analytics generated using these unconnected data silos will be partial at best and could well result in highly misleading conclusions. For example, if our curriculum pathways are not defined in a system that records student satisfaction scores then it will be hard to realise that a subject with very low student feedback scores and poor grades might be consistently linked to students who were granted an exemption from a prerequisite subject. Our data must be carefully curated and highly connected to enable insights beyond the single subject level. And yet it is rare to see a curriculum information system connected to data about either student satisfaction or grades. This means that analysis is often performed in isolated silos – telling only a very small chapter of a far more complex story. This problem becomes even more urgent in the context of university careers services as they shift to models that seek to generate connected communities (Dey and Cruzvergara, 2014). Such models consider all parts of a student's journey, aiming to help them plan, correct course, decide to seek specialised career advice. How might we start to join the dots along a student's lifetime of learning?

An Institutional Perspective: Three UTS Projects in Connected Intelligence

In 2011 UTS embarked on a strategy aimed at realising a *Data Intensive University*

> "where staff and students understand data and, regardless of its volume and diversity, can use and reuse it, store and curate it, apply and develop the analytical tools to interpret it." (Ferguson, Macfadyen, Clow, Tynan, Alexander and Dawson, 2014).

A high priority was learning to appropriately use data and evidence to support the decision making of all stakeholders, defined as the entire UTS community. Consultation with stakeholders suggested that the name of this strategy should be changed to *Connected Intelligence* because it provided a more 'inclusive' branding for non-STEM disciplines, as well as encapsulating the ideas of connecting people, data and processes, in an intelligent, evidence-based approach. In August 2014 The Connected Intelligence Centre (CIC - http://cic.uts.edu.au/) was formed to facilitate this strategy. CIC takes the form of an innovation centre (Buckingham Shum and McKay, 2018), operating as a creative incubator to catalyse thinking about the impact of data and algorithms on education, research, and society more broadly, thus it is a focal point for the university as it tries to move towards achieving connectedness learning at scale. Here, we will explore the concept of lifelong connectedness learning from the perspective of three ongoing

UTS projects that are supported by CIC: student facing analytics for lifelong learning; data portability; and understanding student outcomes in more detail than the Graduate Outcomes Survey (GOS) enables.

Student Facing Analytics for Lifelong Learning

How can we help students to understand the value of the digital traces that they leave throughout a lifetime of learning? The value of those traces might become apparent to students if they can help a student to learn how to learn, so improving their capabilities as a lifelong learner. Existing LA solutions often fall short here, focusing more on reporting a student's rank in a cohort than aiming to provide them with insight about what they are doing as they study, and so helping them learn to learn more effectively (Lockyer, Heathcote and Dawson, 2013). Such insights require that the data describing student interactions with the relevant Learning Management System (LMS) be available at a very fine level of detail. Counts of how many times a student has posted to a discussion forum are not sufficient. We require an understanding of who said what, to whom, and when, so that we can make use of discourse analytics (Ferguson and Buckingham Shum, 2012) to help students think about the *quality* of their connections. For example, a student who merely posts "great idea" to a forum has not helped to develop that idea, or probed it for weaknesses. While it is important that peers learn to encourage one another, it is also essential that they learn how to challenge and question a line of thinking in a community of inquiry, and LA has provided methods for helping us to automate the analysis of this process (Kovanović, Joksimović, Waters, Gašević, Kitto, Hatala and Siemens, 2016). Similarly, what order a student completes a task in is important information that must be preserved in order to build up an understanding of which types of metacognitive processes and self regulation strategies they are developing (Buckingham Shum and Crick, 2016).

Modern LMSs have started to deliver the data that is necessary for these types of analysis, but not all do. Furthermore, it can be difficult to use that data in LA that encourages the types of capabilities that universities are increasingly trying to develop in our students. Some LMSs provide Application Programming Interfaces (APIs) for data extraction, but many do not, and often the vendor delivered solutions do not make it easy for institutional teams to access data at the level of individual events. Analytics depends on the data (Bryant, 2017) but that data is frequently aggregated, inaccessible, or available only to people with administrative status. Tensions often arise between giving access to the teams that need the data, and maintaining the stability and security of systems that are core to university business.

Even if institutional practice has advanced to the point where the necessary LMS data can be collected, many students do the bulk of their learning "in the wild" beyond the LMS, which means that information about the learning they do there (e.g. on YouTube, or in group based Slack conversations, or MOOCs, and in various Blog sites), also provides an important source of information about their process of learning. Work in providing LA beyond the LMS (Kitto, Cross, Waters and Lupton, 2015; Bakharia, Kitto, Pardo, Gašević, and Dawson, 2016) has demonstrated that if care is taken in representing data interoperably using common standards then these sources too can be integrated, so helping to unify data from multiple places and spaces into a collection that tells a far more complete story about a student's learning journey.

Assuming that a university has managed to collect a rich set of data describing the student journey through their systems (no easy feat), the question of how it should be presented to students is largely unsolved. As Teasley (2017) has pointed out, one size does not fit all when it comes to student facing dashboards. It is essential to connect the LA with the pedagogical context that led our students to generate these digital traces. This provides an essential grounding for approaches grounded in data and analytics; many subjects expect their students to be participating in profoundly different activities throughout the course of a semester and this leads to very different behavioural traces. However, generating this form of linkage requires ready access to the learning outcomes for a subject and assessment structure, along with the way in which it progresses over a teaching period (i.e. its learning design). Such data is rarely available to a team developing LA solutions; it is often locked up in spreadsheets and word documents in a variety of Faculty file systems (both physical and virtual).

CIC has an emerging focus on delivering LA that links to the learning design of a subject (Kitto, Lupton, Davis and Waters, 2017; Echeverria, Martinez-Maldonado, Granda, Chiluiza, Conati, and Buckingham Shum, 2018) and is now working to build student facing dashboards that are both user configurable and connect to the learning design of a subject. In the first instance this work will be implemented in a postgraduate environment using the Canvas LMS (https://www.canvaslms.com/). This provides an interesting case in point for the issues discussed above. Canvas is a modern, open source and cloud based LMS which provides an API for data access (https://canvas.instructure.com/doc/api/). This makes it *in principle* possible to deliver real time student facing LA, but the Canvas LA solutions currently provide few insights that would help a student learn how to learn. At UTS, CIC is working with the postgraduate.futures team to build a LA API which will provide access to the required data, via an intermediatory layer. This will form the basis of a loose coupling between a number of core UTS IT systems and various analytics capabilities developed by CIC. This will be a significant advance, as it will move UTS beyond direct point to point connections of various IT systems, instead providing a safe and extensible way to rapidly develop and adopt new solutions that will help to facilitate connectedness learning across the university, that is, at scale.

Data Portability

A related underlying infrastructure project emerges quickly when attempting to deliver LA that collects data over a lifetime. Specifically, in attempting to provide student facing analytics that uses data from multiple systems, and potentially over a lifetime of learning, a number of problems around *data portability* quickly become apparent. There is no guarantee that the data collected from multiple systems will make sense anywhere beyond where it was initially generated. However, new educational data standards have emerged, which offer us a rare opportunity to improve this situation (Griffiths, Hoel and Cooper, 2016), and key to the student facing LA dashboards currently being implemented is the recognition of the need to somehow unify the semantics of the data describing a wide range of social interactions (Bakharia, Kitto, Pardo, Gašević, and Dawson, 2016). We shall return to this more global problem shortly.

Internships and Graduate Outcomes beyond the GOS

As with many other universities, UTS is working hard to understand the employment outcomes of its graduates. Data from the national Graduate Outcomes Survey (GOS - see https://www.qilt.edu.au/about-this-site/graduate-employment) is carefully tracked, but weaknesses in the associated methodology are well understood (see Jackson & Bridgstock, in press). As with many other universities, UTS is looking for more nuanced ways of understanding the outcomes of our students and how they can be improved. This has led to a second collaboration across organisational units in an attempt to build better analytics describing graduate employability. At UTS the data related to this problem is shared across multiple units:

- The Planning and Quality Unit receives the GOS data and uses it to generate KPIs relating to how the university about our graduates perform in the job market.

- The Careers unit understands which students access their training services, internship opportunities and work.
- The Alumni office has bought a dataset that matches past UTS students to profiles on LinkedIn at surprisingly high levels of accuracy (e.g. 40,000 profiles can be matched to UTS records with 98% certainty that they are indeed the same student).
- The IT division maintains a data warehouse containing information about student demographics, courses completed, grades, use of the institutional LMS etc.

Each unit can analyse the data that they have direct access to in isolation, but the full and rich story about a graduate's employability only emerges when it is connected and analysed as a whole. However, this connection must be performed with care - who should have access to and stewardship of datasets like this? And how can they be appropriately analysed? The role of the Connected Intelligence Centre (CIC) as a connection point between these different organisational units is leading to the careful linking up of datasets like this. Perhaps unsurprisingly to those who understand the importance of connectedness learning, analysis of this data has revealed a strong statistical link between undertaking an internship and positive graduate employment outcomes as measured by the GOS 4 months after graduation, across all degrees. Even students from cohorts that have traditionally struggled to find employment have much improved chances of doing so if they have completed an internship. For example, UTS's international students are often not as well connected to the domestic employment market via the soft connections that our domestic students leverage (see also Bridgstock, Jackson et. al. in this volume). This means that their employment statistics are normally substantially lower when compared to domestic students who have achieved similar grade profiles across the same degree. However, the outcomes for this cohort are markedly improved by undertaking an internship. Analyses like these have led UTS to aim for the provisioning of "internship like" experiences for all students. This might take the form of many different models (e.g. a WIL project, capstone embedded in industry, industry posed problems in a "innovation lab" etc.) and represents a massive organisational commitment that is still ongoing.

We see that connecting data across units has helped to support ongoing institutional investment in the work integrated learning component of the connectedness learning model. An effort is now underway to generate additional actionable insights by connecting more data.

Connecting Between Projects

All of these projects have the potential to dramatically change how UTS enables its students to experience connectedness learning. But connecting them together would provide students with even more options over a lifetime of learning. Consider, for example, a student facing LA tool that helps students to understand their current capabilities, storing evidence in an ePortfolio. What if they could explore the employment opportunities in a specific geographical region, using a LA dashboard to match their current skill sets to jobs that they were interested in, working out what skills and capabilities they had strong evidence for, and where they were weak. What if they could perform scenario-based modelling to try and work out the consequences of different curriculum choices that they were considering, linking this to a real time feed about the employment status of students who had followed a similar pathway? Perhaps they would start to use such tools to manage their careers, building a strong professional identity as they went. What would be required to build a suite of such tools?

Firstly, we need authentic mappings of institutional curricula that can somehow be mapped to standard job advertisement datasets that are starting to appear in the HE sector (e.g.

those provided by https://www.burning-glass.com and https://www.monster.com/). Curriculum mappings that are provided by sector wide efforts such as the formalised descriptors used to understand learning outcomes beyond single institutions might help. Examples include the Australian Qualifications Framework (AQF), Scottish Credit and Qualifications Framework (SCQF), and the German Qualifications Framework (Deutsche Qualifikationsrahmen, DQR) at the national level, and the European Qualifications Framework (EQF) at a regional level (Keevy and Chakroun, 2015). However, the mapping of learning outcomes into frameworks such as these is only the first step, and academic teams have often treated educational standards as a compliance exercise rather than an opportunity to ensure that information about student qualifications is indeed portable to other scenarios. How are we to map these sometimes poorly conceived curriculum descriptions to datasets that were created without reference to them? Partial solutions exist already, but we are yet to see any HE institutions attempt to implement them at scale. For example, it is possible to map curriculum documentation into widely understood educational constructs (e.g. Bloom's taxonomy) using simple stemming and text analysis (Gibson, Kitto and Willis, 2014) although it is possible to get far more sophisticated. Publicly available taxonomies of skills, competences, qualifications and occupations exist (e.g. https://ec.europa.eu/esco/resources/data/static/model/html/model.xhtml) which could be extended to qualifications frameworks using natural language processing. CIC is currently working to realise this type of mapping between various curriculum documents and taxonomies describing skills and qualifications more generally.

Is One University Enough?

Even if one university progresses to the point where it could provide this type of connectivity and data portability, will this be sufficient to enable a lifelong connectedness learning experience? E-portfolios require a significant curation effort, which can sometimes be exported to other platforms, but often not. Educators are increasingly moving to the course led curation of professional portfolio tools, such as LinkedIn, to mitigate against this problem (Bridgstock, 2018), but a largely unaddressed problem remains; standard e-Portfolios do not currently link to evidence or proof of the claimed competencies, and so are not much more sophisticated than a traditional *curriculum vitae*, even if they provide many more options for connectivity. Digital Badges are claimed to solve this problem because of the way that they can be linked to metadata about the awarding institution and information about the activities undertaken (Gibson, Ostashewski, Flintoff, Grant and Knight, 2015), but they bring their own problems when we consider how they are currently collected and presented. Even within one institution it is rare to see badges carefully mapped out, and the mappings between digital credentials are still largely underspecified. Hickey and Willis (2017) provide some of the best practice scenarios where badges get aggregated at different levels to combine to larger awards, but much work remains to be completed. Across institutions we see this problem only grow in magnitude. A potential employer is unlikely to understand how the badges awarded by two different institutions relate to one another, which makes comparisons difficult. When the extra granularity of badges is considered (as compared with degrees) we see a further problem: Across a lifetime an individual may collect hundreds of badges. How can they be curated into an interpretable story about an individual's skills and capabilities across multiple institutions?

The problem of lifelong educational data portability is large, and much work remains to be done.

Recommendations for supporting connected universities

What has UTS learned from its Connected Intelligence strategy and its ongoing engagement with other universities? Experience throughout the Australian sector has led to a wealth of examples about what works, and what can go wrong, in creating a connected university. Here, we will try to explicitly state some of the lessons that CIC has learned along the way about the data, institutional connectivity, and IT infrastructure required to support lifelong connected learning. We will frame this discussion in terms of a set of recommendations that might be applied more generally by any university as it moves to a model of lifelong connected learning.

Local Organisational Structures Should Not Dominate Decisions With Wide Impact

Who makes the decisions about software acquisitions at your university? Are all stakeholders equally represented? Or is one organisational unit responsible?

The ability of a degree program to offer Connectedness Learning can be affected by decisions made by many different organisational units including: The Teaching and Learning arm of an institution; an IT division; project management procedures; and even specific Faculty business processes. It is essential that organisations learn how to consider all stakeholders affected by various organisational decisions. Thus, an IT unit that decides to stop support of an institutional Google account, often for very good reasons such as data security, might shut down an entire connectedness learning program overnight. A decision to move core infrastructure such as a Learning Management System (LMS) or Student Information System (SIS) to the cloud could be exceptionally well motivated from the perspective of security, maintenance, and modernity… yet it can have severe repercussions in terms of the ability of other units to offer advanced LA solutions. The in-house and highly customised systems developed by many Australian universities are rapidly being replaced by cloud-based products which often provide marked improvements in usability, but Australian institutions often lack the global influence to demand changes or extensions of functionality. If missing functionality impacts upon the ability of other university units to deliver core functionality then this can become a significant problem. Thus, a failure to consider the broader context in which a system will be deployed can lead to highly adverse outcomes for approaches like connectedness learning that can break quickly if other units are not aware of team requirements beyond their own.

A related set of problems can arise if one organisational unit has core decision making capabilities over systems that affect other units. Organisational culture can mean that different units approach the same problem from markedly different perspectives. For example, do the KPIs associated with an expenses system reside in one unit? Other units might be profoundly affected by how that unit defines business processes. If decisions are made with reference to only one unit's needs then other programs can be profoundly handicapped. This problem often presents in the performance metrics and KPIs of an institution; it is frequently the case in an unconnected university that one unit optimises its own KPIs at the expense of another - this is a key symptom of the need for a change in lines of accountability.

Genuine Data Portability, Access and Control are Essential

The issue of what to do with data, who has the right to access and control it, and how interoperable it needs to be are widely debated (Duch-Brown, Martens and Mueller-Langer, 2017). Many universities are rightly concerned about the ways in which tech giants might misuse personal data (Chakravorti, 2018). Sometimes institutions attempt to regain control of their data through policy settings. For example, bans on the use of social media in teaching are likely to become more common in an attempt to protect the privacy of students. However, this form of action is rarely enforceable, leading academic teams to go underground. More importantly it does our students few favours. We need to teach them how their data is used by various corporations, governments and service providers, opening up the black box of algorithmic decision making and teaching them how to challenge inappropriate classifications (Kitto, Gibson and Buckingham Shum, 2018). If universities step away from the role of teaching our students about how their personal data is used then we might ask who will step into the gap? Connectedness learning offers a very real pedagogical opportunity for exposing students to the varying ways that technology makes use of data, and so improving their understanding of how it might be abused.

Emerging political pressures make this set of issues even more urgent. For example, the European General Data Protection Regulation (GDPR) will have a significant impact upon how we make use of data in HE. Of interest to us here, these laws list a set of 8 rights that pertain to individuals with respect to the digital footprint that they leave as they interface with various IT systems throughout a lifetime, including rights to be informed; access data; object to records; and fix or erase them if incorrect etc. Many of these rights have been implemented by leading European HE providers[1], but, one is proving difficult to realise; *the right to data portability*, which states that:

> "The data subject shall have the right to receive the personal data concerning him or her, which he or she has provided to a controller, in a structured, commonly used and machine-readable format and have the right to transmit

[1] See the Open University student privacy note as an example: http://www.open.ac.uk/students/charter/essential-documents/student-privacy-notice

> those data to another controller without hindrance from the controller to which the personal data have been provided" (https://gdpr-info.eu/art-20-gdpr/)

This right requires that European universities increasingly pay serious attention to the concept of data interoperability, as otherwise educational data will be largely useless beyond the specific institutional context in which it was generated. Even if every university were to adopt one educational data standard (and they do not) most universities would struggle to produce the entire record of a student's interactions within their IT systems. On the contrary, student data is commonly siloed across multiple systems, with markedly different data access protocols and a wide range of custodians in charge of different components (from academics, to administrative officers, counsellors, and librarians). Furthermore, institutions often use terms in different ways, making the portability of meaningful data between them problematic. For example, the AQF requires that graduate attributes are extensively mapped to learning outcomes in the Australian sector, which have been demonstrated to have a marked overlap (Oliver and de St Jorre, 2018). However, the complexity of identifying these commonalities makes these types of mappings very difficult, often taking a large amount of manual labour. Similarly, the definition of a part time or low SES student, and terms such as course, unit, subject, program and module can differ in ways that are subtle but promote ongoing misunderstandings between various stakeholders, especially when mapping to an international context. If genuine portability is to be enabled then we will also have to carefully consider the semantics of our data, ensuring that its meaning can be mapped between different institutions. This means that rather than just a set of issues to be navigated, the right to Data Portability offers a policy driven opportunity to "get our house in order" and to work towards generating educational data that can be used to facilitate lifelong connected learning.

Standards should be followed

Data and technology standards have been developed for a reason. They facilitate the movement of information, metrics, data and analysis beyond the confines of one stand-alone system. Every time a vendor, institution or research group develops its own in-house solution to the representation of data, the specification of competency or the transmission of information, we have lost the ability to escape our silos. Claims are often made that specific standards do not fit the current use case, or that implementation is too difficult, or that something is wrong with how the standard is defined. This is not a useful habit to develop. In a world of lifelong learning we owe it to our students to ensure that the artefacts and data that they generate can be exported to other contexts. The student desire to learn beyond the LMS (Kitto et al., 2015) quickly forces us to recognise that the time spent to map data between different silos is well spent, and a new move is evolving (yet again) to try and standardise interoperable educational data (Griffiths, Hoel and Cooper, 2016).

What is the point in using the educational standards released by organisations like the IEEE[2], ISO[3], ADL[4] and IMS[5]? Many HE institutions do not insist that the products they build or purchase adhere to the various standards that are available, which means that these solutions often use their own in-house syntax and semantics when mapping out educational information. However, much can be gained with a careful application of these standards. For example, in the UK Jisc has implemented a national learning analytics infrastructure which is built upon the xAPI data standard (see https://www.adlnet.gov/research/performance-tracking-analysis/experience-api/). This enables the provision of an ecosystem of services all built off an

[2] http://www.ieeeltsc.org/
[3] https://www.iso.org/committee/45392.html
[4] http://adlnet.gov/
[5] https://www.imsglobal.org/

underlying interoperable data format. It is important to realise that providing this kind of connectivity between datasets and IT infrastructure is non-trivial. To ensure a seamless student experience a large amount of work must be completed at the "back end" of the systems to link them up, and following extant standards can make it far easier to both release data from its silos, and add new technology to the ecosystem of an institution down the track.

IT Couplings Should be Loose Not Tight

Core to the work of building up a connected university is the infrastructure that enables data to move between different systems. Traditionally universities have made use of tight couplings between systems, e.g. the Student Information System (SIS) is directly linked to the LMS to transfer data via a point integration. This makes for a fragile IT infrastructure where it is difficult to move to new IT solutions; changing a system (e.g. a LMS) constitutes a major undertaking. In contrast, modern service-oriented architectures allow for flexible and adaptive solutions to be built, where a university can swap infrastructure in and out as technology evolves, but the overarching user experience does not change.[6] Often, this makes use of an API which works as an intermediate layer providing user facing services (e.g. LA dashboards) with the data they need, regardless of what has changed in the back end infrastructure. We believe that more universities should be following this path. The benefits will be even greater if they connect together in doing so, using *a university API derived from a universal standard*. This would enable different software vendors to interface with the same set of hooks, saving both universities and software providers from the substantial integration efforts that they currently have to undertake every time a new IT product is acquired.

[6] See https://edutechnica.com/2015/06/09/flipping-the-model-the-campus-api/ for an introductory discussion of the power of this approach, along with the ongoing work by Kin Lane on university APIs at http://university.stack.network/, and the blog by Binghamton university which explains their API design: https://developer.byu.edu/blog/method-madness-goals-and-design-decisions-university-api-specification.

Knowledge Sharing Should be Institutionalised and Supported by Infrastructure

Finally, the knowledge gained by various parts of a university is rarely shared in a widely accessible way. This means that even when pockets of best practice emerge their learnings are often unavailable to the rest of the institution. While seminars, events and informal meet-ups are all useful for the transmission of best practice, it is essential that universities start to provide ways to transmit knowledge when needed, just in time. The staff member who is trying to work out how to do something *right now* cannot wait until the end of year forum to find out how another group solved their problem. For example, as data warehouses are increasingly used across an institution, how many groups are consistently reinventing the wheel?

Internal web pages and wikis are frequently provided by institutions to help staff record information as required. Unfortunately, they are rarely kept up to date, and often result in redundant information that is factually incorrect and can even be conflicting. More modern knowledge repositories provide an excellent solution to this problem, but few universities make use of these best practice solutions. Tools such as Knowledge Repo (http://knowledge-repo.readthedocs.io/) enable groups in different organisational units to share knowledge across the entire institution using a service that aggregates code repositories and documents without duplication, but other solutions exist.

Regardless of the solution chosen, a connected university will only prioritise knowledge sharing if there is a genuine staff commitment to this process, and yet we rarely see this type of institutional citizenry recognised by KPIs or other awards. The connected university is one where people share knowledge because it is recognised as important, not one where they are told to do so. Senior management would do well to consider ways in which they can create a culture of knowledge sharing at their institution.

Towards the Future

These recommendations are only the tip of an iceberg. Implementing connectedness learning across the lifetime of our students is a mammoth task. But as we discussed at the outset, the changing nature of work creates a strong imperative to do so if we are genuinely taking the interests of our students into account. But what benefits await a university that attempts this venture? Could it be worth the effort?

If data portability is taken seriously, then it would enable us to give our students access to Personal Data Stores (PDS) that they could take with them for life. They would be able to directly interface with employers using ePortfolios that are verifiable, and which contain directly accessible evidence of their evidence of their skills and capabilities. If these were implemented with a full consideration of the personal rights associated with the GDPR then our students would have ways to control access to that data. They would be able to create different views of their skills and capabilities for different potential employers. They would be able to update their PDS while training at work, and use it to get recognition of their prior learning if they decide to return to university. A PDS could be used to *personalise* the student experience, helping our students to select a pathway through a university system that suits them. Being able to offer this type of individual service to students is a key differentiator that many universities are currently working to deliver, but without the underlying connected data it will be very difficult to achieve.

Conclusions

Learning happens throughout a lifetime, and all universities would do well to recognise that they are only a part of the journey that each of their students have embarked upon. It is fast becoming essential for universities to provide *lifelong* connected learning, where our graduates can demonstrate their skills and competencies not just to potential employers, but to other HE providers as they attempt to navigate the changing nature of work. We have discussed the complexities associated with providing this level of service, pointing to key recommendations that have emerged from UTS as it attempts to deliver infrastructure capable of supporting this overarching goal. We welcome other institutions that are willing to connect with us on this journey.

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