An Overview of Learning Analytics in Higher Education

Amy Wong, Marcel Lavrencic, Hassan Khosravi
Institute for Teaching and Learning Innovation
The University of Queensland

1. Introduction

The big data revolution has empowered universities with rich and complex digital data on their learners. Through digitally mediated activities conducted online or on-campus, students leave behind digital footprints that can be mined to enhance student learning and teaching, and assessment practices. To help contextualise data analytics in the educational setting, a new vibrant field called learning analytics has emerged. This area is interdisciplinary, drawing upon research, methods, and techniques from education, psychology, data mining, machine learning, and visualisation. Learning analytics is defined by the Society for Research in Learning Analytics (SoLAR) as "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs."[1]. Definitions that are more informal include "learning analytics is about collecting traces that learners leave behind and using those traces to improve learning"[2] or learning analytics is "the process of developing actionable insights through problem definition and the application of statistical models and analysis against existing and/or simulated future data"[3].

With the rise of learning analytics, many higher education institutions (HEIs) seek to apply innovative analytic approaches that assist key stakeholders to enhance the learning experience of students. Figure 1 shows how learning analytics can enable different stakeholders to contribute to personalising education and translating traditional on-campus learning to authentic flexible learning in vibrant digital environments that better suit the needs and expectations of a digitally minded generation.

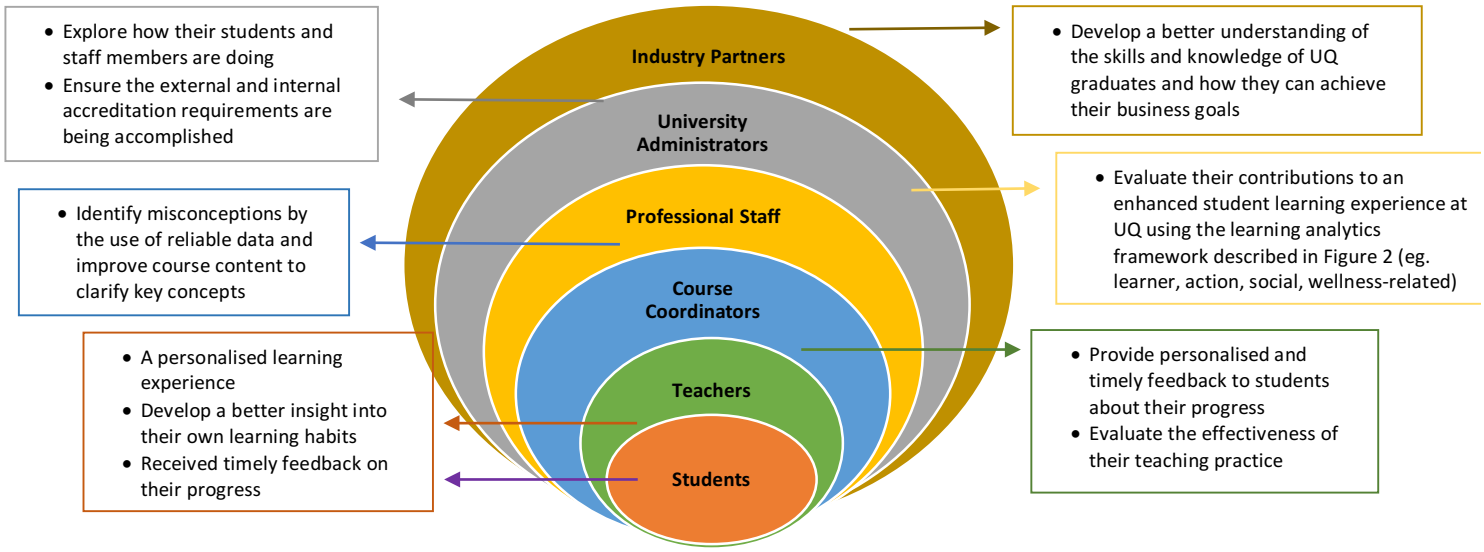

Figure 1. Ways that learning analytics enhances student learning experience through different key stakeholders.

[1] Siemens, G. (2011). *Learning and Academic Analytics*. Retrieved from http://www.learninganalytics.net/?p=131
[2] Duval, E. (2012, January 30). *Learning Analytics and Educational Data Mining* [Web log message]. Retrieved from https://erikduval.wordpress.com/2012/01/30/learning-analytics-and-educational-data-mining/
[3] Cooper, A. (2012). What is Analytics? Definition and Essential Characteristics, *CETIS Analytics Series, 1*(5). http://publications.cetis.org.uk/2012/521

At the same time, HEIs are operating in an increasingly complex environment. Institutional data sets are usually stored in a variety of formats across multiple data centres that are often incompatible with one another. Supporting learning analytics needs of different stakeholders in a timely manner is a challenge that many institutions are current facing.

This paper provides an overview of the recent national and international initiatives, adoptions, and challenges around learning analytics. It aims to assist the Learning Analytics Steering Group in setting the context and priorities in the adoption of learning analytics at The University of Queensland (UQ), as we embrace the opportunities and challenges big data creates in higher education.

2. Learning Analytics Initiatives

An overview of the primary data sources and analytics initiatives is shown in Figure 2, which is based on the empirical learning analytics reports published in recent educational literature.

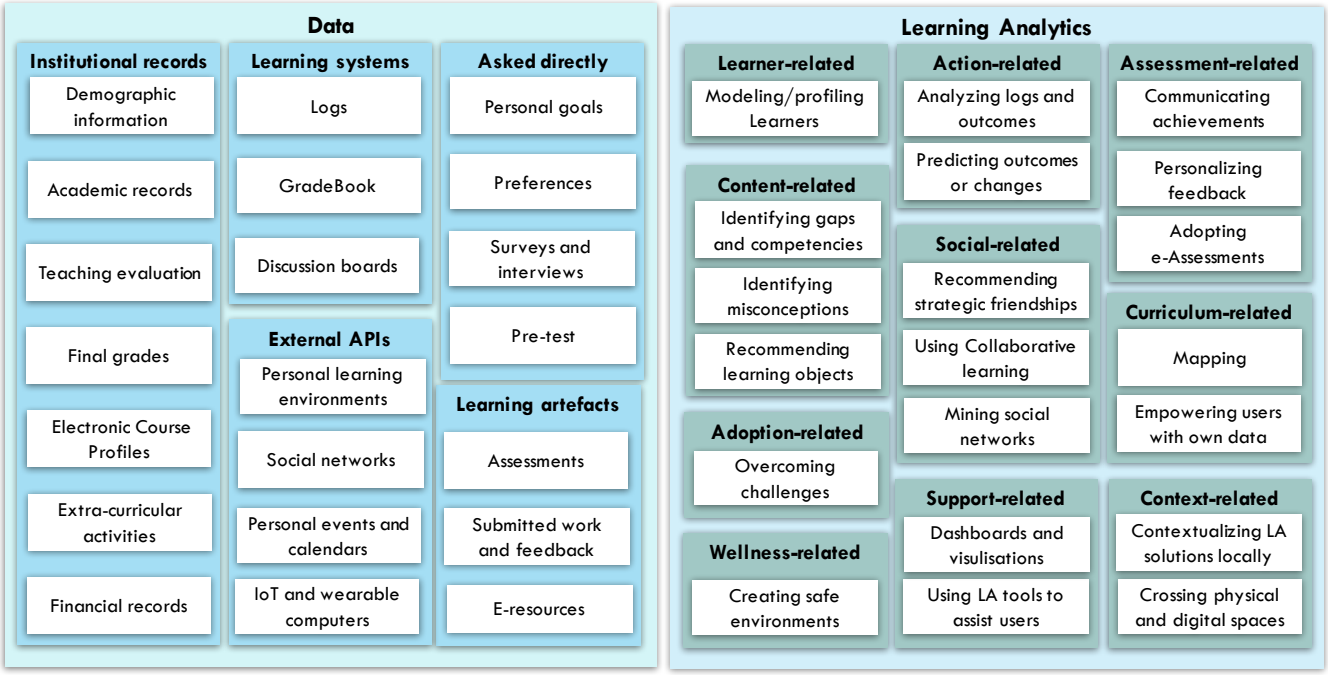

Figure 2. An overview of the primary data source and analytics initiative performed in recent years.

The sources of data used include institutional records (e.g. demographic information and academic records), learning systems (e.g. logs from Blackboard), external APIs (e.g. personal learning environments and social networks), learning artefacts (e.g. assessments), and asking questions directly from the students (e.g. questionnaires).

The learning analytics initiatives include topics that are:

- learner-related, attempting to model the behaviour of the learners
- action-related, analysing learner's logs and predicting outcomes
- assessment-related, communicating requirements and achievements, and personalising feedback
- content-related, identifying knowledge gaps, competencies, and misconceptions
- social-related, promoting learning in a social environment
- curriculum-related, assisting in mappings of objectives and competencies to graduate attributes
- adoption-related, discussing challenges and solutions around adoption of learning analytics
- wellness-related, developing tools and interventions that support the wellness of students

- support-related, developing tools that support key stakeholders in teaching and learning
- context-related, contextualising learning analytics solutions based on the "analytics tone" of the HEI.

Translating educational data into meaningful, strategic recommendations requires a competent learning analytics team. The team should include: university leaders who can set the "analytics tone" of the institution and its related policies, data scientists who can apply innovative analytic approaches, IT experts who can integrate solutions into the universities existing infrastructure, teaching and learning scholars who have a thorough understanding of the higher education context, and student representatives who can communicate the needs and preferences of the student population.

3. Learning Analytics Adoption

An example of the systemic approach to learning analytics is the Supporting Higher Education to Integrate Learning Analytics (SHEILA) project[4], which has been developed to "assist European universities to become more mature users and custodians of digital data about their students as they learn online".

Studies have shown that most HEIs are still in a preparatory or early stage of adoption, that is, showing awareness of analytics and using some basic reports. As such, the main deliverable of the SHEILA project is a policy development framework that supports HEIs in learning analytics adoption and implementation. This project uses a modified (Research and Policy in Development) RAPID Outcome Mapping Approach (ROMA)[5], which has the following steps: (1) map political context, (2) identify key stakeholders, (3) identify desired behaviour change, (4) develop engagement strategy, (5) analyse internal capacity to effect change, and (6) establish monitoring and learning frameworks. The outputs will be validated through case studies, using the policy framework to guide the development, implementation, and evaluation of LA policy and strategy in four HEIs in different regions of Europe.

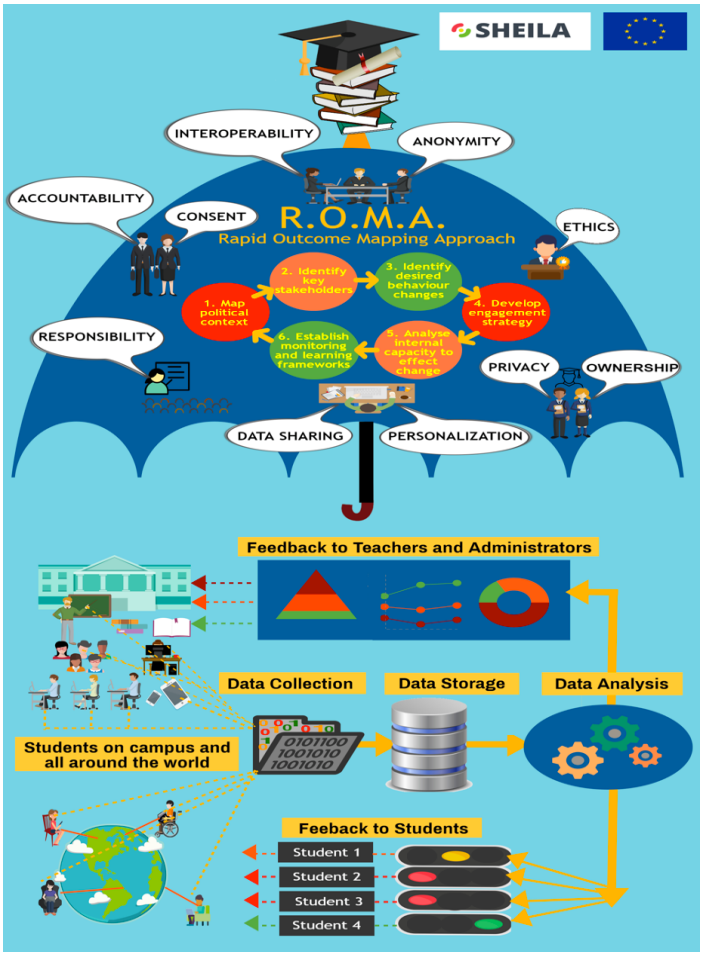

Figure 3. An overview of the SHEILA project.

4. Challenges of Institution-wide Adoption of Learning Analytics

The challenges of implementing institution-wide learning analytics include both procedural concerns and practical applications. Universities store large amounts of data that are often incompatible due to the differences and complexity in various data structures. Catering to the data access needs of diverse stakeholders using data, which are primarily collected for operational purposes, is one of the main

[4] SHEILA (2017). Using data wisely for education futures. http://sheilaproject.eu/
[5] Young, J., & Mendizabel, E. (2009). *Helping researchers become policy entrepreneurs*. London: Overseas Development Institute.

challenges. In addition, academics and professional staff are required to obtain approvals from multiple data owners to have access to these data. Hence, there is an extended lag time between the data being collected and analysed. This delay reduces the effectiveness of the implemented changes in teaching practices[6].

Another challenge lies in determining the institutional learning analytics priorities by selecting the right questions to ask based on the available data. The decision of these priorities establishes the "analytic tone" of an institution in terms of directing resources to identified data sources to answer specific questions with an institution-wide approach. Furthermore, the challenge from the perspective of practical applications of learning analytics is to make reasonable and logical interpretations of the data collected. For example, the number of clicks or downloads on the learning management system (LMS) such as Blackboard should not necessarily be interpreted as student engagement with online learning. Therefore, the validity issues should be carefully considered and justified when interpreting student learning data and the learning analytics outcomes.

Finally, challenges from the perspective of leadership, training and policies are summarised in a recent paper as follows[7]:

- lack of institutional leadership for strategic implementation and monitoring
- uneven engagement with different key stakeholders
- inadequate training to learn to use learning analytics in the context of teaching and learning
- absence of policies for learning analytics practices.

The difficulties in resolving these challenges are reflected by the fact that most of the HEIs are still in the "Experimentation"/"Organization" stage in the learning analytics sophistication model (Figure 4). Addressing the procedural concerns and practical applications, as well as establishing strategic leadership and monitoring is crucial for HEIs to move towards the stage of "Organizational Transformation".

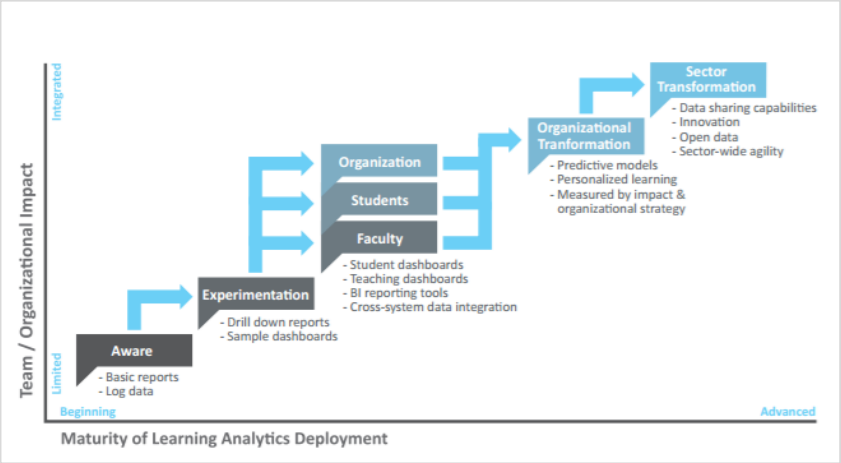

Figure 4. Learning analytics sophistication model[8].

[6] Kennedy, G., Corrin, L., and De Barba (2017). Analytics of what? Negotiating the seduction of big data and learning analytics, *Melbourne Centre for the Study of Higher Education,* 67-76. http://melbourne-cshe.unimelb.edu.au/

[7] Tsai, Y-S., and Gasevic, D. (2017). Learning analytics in higher education – challenges and policies: A review of eight learning analytics policies, *Proceedings of the Seventh International Learning Analytics & Knowledge Conference,* 233-242, doi: 10.1145/3027385.3027400

[8] Siemens, G., Dawson, S., and Lynch, G. (2014). *Improving the Quality and Productivity of the Higher Education Sector – Policy and Strategy for Systems-level Development of Learning Analytics.* Canberra, Australia: Office of Learning and Teaching, Australian Government. Retrieved from https://pdfs.semanticscholar.org/d307/34019734c219f6ab83af3dcebfa39c9e8b84.pdf

5. Learning Analytics at UQ

According to the Student Strategy 2016-2020: White Paper[9],

> "Learning analytics can assist students and staff by providing information that enhances learning and teaching by supporting adaptation in the practices, processes and systems of the University such as improvements in assessment. It enables a more personalised management of the relationship between the University and its students by managing online learning, feedback and support systems. (p.19)"

UQ is currently in the preliminary stage of maturity moving from the "Experimentation" to "Organisation" stage (Figure 4) in terms of learning analytics deployment. The definition outlined above indicates that the direction to reach the "Organisational transformation" stage is necessary to enable personalised learning to be delivered at UQ. Based on the report on "Towards… The UQ student strategy: an open discussion on the UQ green paper"[10], 72% of students who responded to the student survey indicated that regular information on how their learning is tracking with course objectives via an online platform would be welcomed.

One of the responses to the need to provide students with data about their on-going progress, and to ensure that students understand and act upon the data is the development of a student-centred dashboard. This decision is in line with the UQ Student Strategy which emphases that "students as change agents" to maximise their learning and development of skills[9]. The initial phase of the student dashboard has been successfully completed in February 2017, with the expectation that it will be continually developed with a staged approach.

Other examples include:

1. Learning Enhancement Management System (LEMS) at the Faculty of Science
   LEMS with the iMark system is an in-house application to facilitate a more efficient means to record student assessment outcomes, as well as to provide students with timely feedback about their ongoing progress. The aims of LEMS is to enable academic staff to track individual student and class performance throughout the semester. Information about class demographics is also available to assist staff to develop a better understanding of their student cohort.

2. Centre for eLearning Innovations and Partnerships in Science and Engineering (eLIPSE)[11]
   eLIPSE provides support for eLearning innovation and research which is well grounded in the curriculum and led by academics who are involved in teaching practice. Examples of current projects include:
   - The JourneyMaker (tJM): a web-based version of curriculum design and visualisation tool to describe development of knowledge, skills, and personal attributes.
   - Learning Pathway (Stage 1): a navigational interface in Blackboard sites that provides students with a clear visual roadmap through their course to help them stay on course.

A thorough audit of the learning analytics initiatives and activities at UQ will assist in recognising our strengths and limitations in learning analytics implementation.

---

[9] The University of Queensland (2016). *Student Strategy 2016-2020: White Paper*. https://student-strategy.uq.edu.au/files/453/Student-Strategy_White-Paper.pdf

[10] Institute for Social Science Research (2016). *Consultation Outcomes. Towards… The UQ Student Strategy: An Open Discussion on the UQ Green Paper Full Report.* https://student-strategy.uq.edu.au/files/121/Green_Paper_Consultation_Comprehensive_Report_2016-02-26_FINAL.pdf

[11] Centre for eLearning Innovations and Partnerships in Science and Engineering (2017). eLIPSE. https://www.elipse.uq.edu.au/home