



# Developing evidence based and innovative learning design using learning analytics

**Shaun Boyd and Charlotte Brack**

2014 Higher Education and Skills Group International Fellowship

**An ISS Institute Fellowship sponsored by**

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*Unless otherwise indicated, all images included in this report were created by Shaun Boyd © Melbourne Polytechnic 2015*



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# i. EXECUTIVE SUMMARY

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The use of educational technologies has many benefits for learners, teachers, institutions and industry. The most immediate impact is derived from the flexibility with respect to time and place of learning and teaching; however many other factors are emerging. While the principles of good teaching apply equally in traditional (face-to-face) and technology enhanced training and education, the latter leaves a trail of interactions that can give insight into the nature of the learning occurring. These trails become visible through interpretation of 'learning analytics' which can then be used to improve the design for learning and teaching. While data mining and predictive analytics have been used in relation to business (e.g. tracking customer behaviour) its effective use in relation to training and education is in its infancy.

The Horizon Report<sup>1</sup> into higher education for 2013 noted that, "While the practice of analysing student-related data is not new, the field of learning analytics has only recently gained wide support among data scientists and education professionals" (HR, 2013, p.26). Campbell and Oblinger<sup>2</sup> described academic analytics as an, "Engine to make decisions or guide actions" that consists of five steps: capture, report, predict, act, and refine. Techniques that make data accessible to teachers (non-technical staff) explore 'dashboard' technologies to provide the 'right information' to the 'right people' to get a meaningful report from the information that the data contains. Dashboard technologies have the potential to bridge the gap between analytics and learning design, facilitating tailoring learning for individuals.

This program enabled Shaun Boyd and Charlotte Brack to attend conferences, and participate in workshops, that are on both ends of the learning analytics spectrum – one that focussed on the academic planning and performance and the other that looked at the use of learning analytics from a data mining microscopic point of view. Both of these areas enabled the Fellows to obtain a broad view on the research and practice that has been happening in the field, yet enabled the Fellows to observe some of the current research and practices that were contributing to the field.

The work that The Open University UK is currently undertaking in relation to student retention and progress through the OU Analyse dashboard tools is a technology that could immediately be adopted for broad usage across institutes. The OU Analyse tool is currently being used to assist with students at risk of failure in subjects.

Throughout the journey into understanding and further more applying the discoveries that were made through the research, Boyd and Brack propose that the use of learning analytics should be widely adopted within institutes that participate in any form of online delivery, whether that be through a blended or fully online approach.

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<sup>1</sup> Johnson, L., Adams Becker, S., Cummins, M., Estrada, V., Freeman, A., and Ludgate, H. NMC Horizon Report: 2013 Higher Education Edition. 2013

<sup>2</sup> Oblinger, D. G. and Campbell, J. P. Academic Analytics, EDUCAUSE White Paper, 2007

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## ii. ABBREVIATIONS/ACRONYMS

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<b>EDM</b>	Education Data Mining
<b>HE</b>	Higher Education
<b>ITS</b>	Information Technology Services
<b>MOOC</b>	Massive Open Online Courses
<b>MP</b>	Melbourne Polytechnic (formerly NMIT, Northern Melbourne Institute of TAFE)
<b>OU</b>	The Open University UK
<b>SoLAR</b>	Society of Learning Analytics Research
<b>STLHE</b>	Society of Teaching and Learning in Higher Education
<b>VET</b>	Vocational Education and Training
<b>VLE</b>	Virtual Learning Environment

## iii. DEFINITIONS

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### **Adaptive Learning**

Is an educational method which uses computers as interactive teaching devices. Computers adapt the presentation of educational material according to students' learning needs, as indicated by their responses to questions and tasks.<sup>1</sup>

### **Circos Plot Diagram**

Is visualised data displayed in a circular layout.

### **Dashboard technologies**

A graphical interface that displays the current status of metrics and key performance indicators.

### **Data Mining**

The practice of examining large pre-existing databases from different perspectives and summarising it in order to generate new information.

### **Interactive hierarchical edges**

A hierarchical database is a design that uses a one-to-many relationship for data elements.

### **Learning Analytics**

Is 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. A related field is educational data mining.<sup>2</sup>

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<sup>1</sup> Paramythis, A. and Loidl-Reisinger, S. Adaptive Learning Environments and e-Learning Standards. *Electronic Journal of eLearning.*, 2004

<sup>2</sup> Siemens, G. What Are Learning Analytics? *Elearnspace*, August 25, 2010.

# 1. ACKNOWLEDGEMENTS

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The Fellows thank the following individuals and organisations that have generously given of their time and their expertise to assist, advise and guide them through this Fellowship program.

## **Awarding Body – International Specialised Skills Institute (ISS Institute)**

The International Specialised Skills Institute (ISS Institute) is an independent, national organisation. In 2015 it is celebrating twenty-five (25) years working with Australian governments, industry education institutions and individuals to enable them to gain enhanced skills, knowledge and experience in traditional trades, professions and leading edge technologies.

At the heart of the ISS Institute are our individual Fellows. Under the Overseas Applied Research Fellowship Program the Fellows travel overseas. Upon their return, they are required to pass on what they have learnt by:

- Preparing a detailed report for distribution to government departments, industry and educational institutions
- Recommending improvements to accredited educational courses
- Delivering training activities including workshops, conferences and forums.

Over 350 Australians have received Fellowships, across many industry sectors. In addition, recognised experts from overseas conduct training activities and events. To date, 30 leaders in their field have shared their expertise in Australia.

According to Skills Australia's 'Australian Workforce Futures: A National Workforce Development Strategy 2010'.

*Australia requires a highly skilled population to maintain and improve our economic position in the face of increasing global competition, and to have the skills to adapt to the introduction of new technology and rapid change. International and Australian research indicates we need a deeper level of skills than currently exists in the Australian labour market to lift productivity. We need a workforce in which more people have skills and knowledge, but also multiple and higher level skills and qualifications. Deepening skills and knowledge across all occupations is crucial to achieving long-term productivity growth. It also reflects the recent trend for jobs to become more complex and the consequent increased demand for higher-level skills. This trend is projected to continue regardless of whether we experience strong or weak economic growth in the future. Future environmental challenges will also create demand for more sustainability related skills and knowledge across a range of industries and occupations.*

In this context, the ISS Institute works with our Fellows, industry and government to identify specific skills and knowledge in Australia that require enhancing, where accredited courses are not available through Australian higher education institutions or other Registered Training Organisations. The Fellows' overseas experience sees them broadening and deepening their own professional knowledge, which they then share with their peers, industry and government upon their return. This is the focus of the ISS Institute's work.

For further information on our Fellows and our work see <http://www.issinstitute.org.au>.

The Fellows also thank the CEO (Bella Irlight AO) and staff (Ken Greenhill and Paul Sumner) of ISS Institute for their assistance in planning and development of the Fellowship and completion of this report.

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## 1. ACKNOWLEDGEMENTS

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### Fellowship Sponsor

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### Supporters

- Melbourne Polytechnic
- Frances Coppolillo, Deputy CEO and Head of Programs, Melbourne Polytechnic
- Dr. Christine Spratt, Senior Lecturer (Clinical Learning), Interprofessional Education Program, Chair IHEP Conference Steering Committee, Office of the Pro Vice-Chancellor, Industry, Community and Sport Engagement, Victoria University
- Dr. Grace Lynch, Adjunct Professor Learning Analytics, University of New England, Executive Manager - Society for Learning Analytics Research
- Melanie Worell, Managing Director – The Klevar Group P/L, Executive member of EINet (the E-learning network of Australasia)
- Berwyn Clayton, Director – Work-based Education Research Centre, Victoria University
- The Institute of Educational Technology, Learning and Teaching, The Open University UK

## 2. ABOUT THE FELLOWS

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### **Shaun Boyd**

Shaun Boyd has considerable national and international experience with setting up and using technology systems to provide efficiencies and flexibility for teaching and learning.

As a former teacher, Shaun brought principles of good teaching and learning to the development and management to fully online learning environments. He has been working at Melbourne Polytechnic's for over five years in the design, development, implementation, and support of educational technologies across all program areas.

Boyd's goal is in the provision of high level technical and administrative support for the institutional Educational Technologies to a variety of stakeholders across the institutes teaching communities to ensure efficient workflow and delivery of prompt, quality service.

His more specific interests lie in the bridging of computer science with the sociology of learning through the use of learning analytics and educational data mining to better understand the students and the technology environments in which they learn.

### **Dr Charlotte Brack**

Dr Charlotte Brack has over fifteen years' experience in Teaching and Learning online. She started designing for online learning in her academic field of Biochemistry, creating interactive multimedia modules for learning about molecular mechanisms.

She has since worked in online learning across multiple discipline areas at several institutions, developing particular interests and expertise in online collaboration, learner creation of content and assessment.

Dr Brack has responsibilities for online learning in Higher Education at Melbourne Polytechnic (MP).

Both Fellows were directly involved in the planning and development of this Fellowship research, but due to the pressure of changed employment situation at Melbourne Polytechnic (formerly Northern Metropolitan Institute of TAFE), only one (Shaun Boyd) travelled overseas and conducted the research investigation. Both Fellows have been involved in preparing and writing this report.

## 3. AIM OF THE FELLOWSHIP PROGRAM

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The Fellowship research and investigation was looking to establish a fundamental understanding of current learning analytics techniques and their application by teachers in the design of online training and education encompassing learning and teaching so that learning design is evidence based and innovative.

Empowering teachers to use learning analytics will enable rapid responses to market forces in training and education including:

- The pressure for quality educational experiences;
- The demand for increased transparency of learning outcomes;
- Exponential growth in student numbers;
- Supporting access and individualised learning in diverse student cohorts.

The involvement of Boyd and Brack in the Fellowship will contribute the following tangible impacts:

1. Supporting the development of learning analytics at Melbourne Polytechnic.
2. Developing expertise in the design and implementation of tools to facilitate the use of learning analytics by teachers to improve learning design.
3. Contributing to design and development in the use of educational technologies in tertiary education.
4. Design and develop a comprehensive dissemination strategy using contemporary digital technologies.
5. Establish relationships between identified partners and Melbourne Polytechnic for ongoing benchmarking and other collaborative educational and applied research opportunities.
6. Establish relationships with international peers in the field of learning analytics.
7. Share findings across the training and education sector broadly.

# 4. THE AUSTRALIAN CONTEXT

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Key aspects of national strategies for development in the training and education industry relevant in this application include:

- **Teacher capacity.** The Innovation and Business Skills Australia (2013) Environment Scan<sup>1</sup> indicates that a critical element of the Digital Education Revolution (DER) sponsored by the Australian Government is developing, “Teacher capability – i.e. ensuring they have the skills and tools to design and deliver programs that meet student’s needs and harness the benefits and resources of the digital revolution” (p. 19).
- **Growth in broadband based training.** The National VET E-learning Strategy 2012-2015<sup>2</sup> aims to promote growth in broadband based training; support the adoption of industry wide e-learning programs; develop e-literacy; and improve access to training. The strategy seeks to, “Create more accessible training options and facilitate new ways of learning through technology, while stimulating new ventures in e-learning to support individual participation in training and employment, and the alignment of workforce skill levels with economic needs” (p. 7).

Learning analytics has the potential to provide teachers with information and tools for decision making and encourage the use of technology in a range of learning contexts. The use of technology for learning provides further data for analysis facilitating an ongoing cycle for continuous improvement. Providing teachers with access to learning analytics tools and training in how to use these tools contributes to developing e-literacy and facilitates the development of targeted and effective e-learning approaches.

## SWOT Analysis

### Strengths

- Expertise in online learning
- Build on other key areas of institute strategies, teaching, learning and assessment
- Impact on student experience

### Weaknesses

- Lack of Business Intelligence in workplace to respond to potential findings
- Constraints on adopting the potential findings due to human resource limitations
- Current good practice not widespread or sustainable

### Opportunities

- Greenfields in widespread understanding and adoption
- Building of BI capability to support other key institutional drivers
- Enhancement and value adding of services and systems

### Threats

- Institute ability to keep abreast of national agendas/initiatives
- Infrastructure and funding constraints on adopting potential findings
- Access to data through external provider impeded

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<sup>1</sup> Innovation and Business Skills Australia, Environment Scan: Training and Education Industry, Department of Industry, Science, Research and Tertiary Education. Canberra, 2013.

<sup>2</sup> Flexible Learning Advisory Group, National VET E-learning Strategy 2012-2015. Australian Department of Education, Employment and Workplace Relations (DEEWR) 2012

# 5. IDENTIFYING THE SKILLS AND KNOWLEDGE ENHANCEMENTS REQUIRED

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There are examples of areas in Australian industries and activities where there are weaknesses in skills, knowledge, experience, innovation, policies and/or formal organisational structures to support the ongoing successful development and recognition of individuals and the particular sector.

The focus of all ISS Institute Fellowships is on applied research and investigation overseas by Australians. The main objective is to enable enhancement and improvement in skills, knowledge and practice not currently available or implemented in Australia, and the subsequent dissemination and sharing of those skills and recommendations throughout the relevant Australian industry, education, government bodies and the community.

Specific skill enhancement areas addressed through the Fellowship were as follows:

## **Skills enhancement 1: Record and investigate sources of data relevant to learning and teaching**

- Identify what data to retrieve (from vast amount available).
- Identify sources of data and methods of retrieval.
- Assess relevance to learning and teaching in an Australian context.
- Learn methods for preliminary sorting of data.
- Investigate output formats.

*Action: Develop a list of data queries, sources and recommendations for data retrieval and preliminary questions for sorting.*

## **Skills enhancement 2: Strategically and systematically analyse data**

- Investigate the new techniques for analysis of data.
- Relate analyses to data queries.
- Identify applications.

*Action: Document analysis techniques, their underpinning strategies and assumptions and applications.*

## **Skills enhancement 3: Bridging the gap for teachers - dashboard technologies**

- Investigate existing dashboard technologies.
- Explore relevance of dashboard technologies as a tool for teachers to access and analyse data.
- Explore design of dashboard technologies with respect to structure and function.

*Action: Draft key elements for dashboard design.*

## **Skills enhancement 4: Using dashboard technologies - exemplars**

- Investigate the use of dashboard technology in an action cycle from query to learning design.

*Action: develop a plan for using the dashboard technologies to support learning design.*

## 6. THE INTERNATIONAL EXPERIENCE

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The International experience involved participation at two conferences in Canada and UK (see below); a presentation was made by the Fellow at the first conference in Canada, along with two separate site visits to targeted groups at The Open University, Milton Keynes, Buckinghamshire, UK. Initially the Fellow anticipated attending three separate conferences, however due to unforeseen circumstances this did not occur, see appendix 1.

### Conferences

#### **Conference 1: Society for Teaching and Learning in Higher Education 33rd Annual Conference 2014 – STLHE – Transforming our learning experiences. 17 to 20 June, 2015; Queens University, Kingston, Ontario, Canada**

The conference and workshops were held over four days on the shores of Lake Ontario in the town of Kingston, Canada at Queens University and in conjunction with the partner institutions St Lawrence College and Royal Military College.

STLHE strives to be the pre-eminent national voice, and a world leader, for enhancing teaching and learning in higher education. The Society supports research, its dissemination, increased awareness, and application of research through scholarly teaching and learning.



As the theme for the STLHE conference was 'transforming our learning experiences', the Fellow (Boyd) presented a paper titled 'Analytics and Online Learning in an Australian Tertiary Institution'. This allowed Boyd to become a more visible participant in the conference proceedings and to participate effectively in discussion about the use of and implementation of learning analytics. The proposed conference discussion paper topic was listed in the conference program, and is included in this report as Appendix 2.

#### **STLHE 2014 – Pre-Conference Workshop**

The Fellow attended a pre-conference workshop 'Transforming our Learning Experiences: Paradigms and Paddling Pedagogies'. The premise of the workshop was to be a day-long workshop exploring the St Lawrence Islands by canoe or kayak, while engaging in conversations and tours that related to the conference theme of transformation.

This theme of "transforming our learning experiences" related in a poignant way to the research that the fellows were undertaking. The premise in using learning analytics to assist teachers in course design was one of the key areas of the fellowship research. This is tied to working with the ability to further assist teaching staff in their delivery across the online learning environments.

The workshop leaders were Alan Wright, University of Windsor; Alice Cassidy, In View Education and Professional Development; Marie-Jean Monette, University of Windsor; William B. Streat, University of Alberta; Gavan Watson, University of Guelph - all experienced outdoor education specialists who were as comfortable in a canoe or kayak as they were in front of the teaching and learning theory. This combination of interests lent itself succinctly to the title of the workshop, 'paradigms and paddling pedagogies'.

## 6. THE INTERNATIONAL EXPERIENCE

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While canoeing across the St Lawrence River from the berth on the Kingston foreshore, the group fell into a rhythm of combined interest in the paddling while discussing some of the latest developments in learning and teaching at their various institutes. With the conference being held in the historic Kingston and the landscape of the area dominated by the tip of Lake Ontario, history and outdoor education became topics of discussion that were high on participants' agendas.

There were several notable conversations about education in general and some more specific topics of interest. A fellow academic from a South Australian institute was interested in the area of research that was being undertaken as part of the Fellowship and expressed satisfaction that a person from a TAFE background was attending and participating in STLHE. The discussion was based around the premise of using the data collected in the various systems and learning systems that are readily available to the academic staff at a particular institute. They noted that it was, "Fantastic to be involved in a forward thinking project - and more notable that the research was coming out of a TAFE institute".<sup>1</sup>



### **Conference 2. The 7th International Conference on Educational Data Mining. Big Data - Big Ben - Education Data Mining for Big Impact in Learning and Teaching; 4 to 7 July, 2015, Institute of Education, University College London, London, England.**

The Educational Data Mining community while apparently small in numbers and centred on a very North Atlantic group of participants, drew a small representative contingent from East Asian and Australian locations. The conference participants were a mixture of experienced to very experienced researchers, along with a notable group of 'young' researchers (mainly participants who were in the midst of working towards their doctorate), from the data mining communities. The conference participants were drawn from a wide ranging group of tertiary education institutions with the vast majority being university based researchers, though there were small representative groups from corporate, military, and leading educational research centres.

#### **Pre-conference workshops**

The first day of the conference was broken up into a series of full-day workshops and short session tutorials each with a particular focus to, "Provide an opportunity to share novel ideas on current and emerging topics relevant to Educational Data Mining and favour highly interactive discussions"<sup>2</sup>

There were workshops on Graph-based Educational Data Mining, Non-Cognitive Factors & Personalisation for Adaptive Learning, Approaching Twenty Years of Knowledge Tracing: Lessons Learned, Open Challenges,



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<sup>1</sup> STLHE Conversation 1, 2014. At STLHE 2014: with Dorothy Missingham from Adelaide University

<sup>2</sup> EDM Conference proceedings, 2014

## 6. THE INTERNATIONAL EXPERIENCE

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and Promising Developments and Feedback from Multimodal Interaction in Learning Management Systems.

The tutorials addressed: Getting Started with RapidMiner; An Overview of Clustering: Finding Group Structure in Educational Research Data; a tutorial on Epistemic Network Analysis (ENA); and a tutorial on the Replicability and Generalisability of Instructional Technology Studies (WRGITS).

Boyd participated in the full day workshop on Graph-based Educational Data Mining as, “Graph data has become increasingly prevalent in data-mining and data analysis”.<sup>3</sup>

The papers and discussions presented as part of the workshop included the following:

- A Binary Integer Programming Model for Global Optimization of Learning Path Discovery
- On-Line Plan Recognition in Exploratory Learning Environments
- What is the Source of Social Capital? The Association between Social Network Position and Social Presence in Communities of Inquiry
- Cross-Domain Performance of Automatic Tutor Modeling Algorithms
- AGG: Augmented Graph Grammars for Complex Heterogeneous Data
- Graph Mining and Outlier Detection Meet Logic Proof Tutoring
- Snag'em: Graph Data Mining for a Social Networking Game
- Social Positioning and Performance in MOOCs
- Facilitating Graph Interpretation via Interactive Hierarchical Edges
- Evaluation of Logic Proof Problem Difficulty Through Student Performance Data
- InVis: An EDM Tool For Graphical Rendering And Analysis Of Student Interaction Data.

The paper on Facilitating Graph Interpretation via Interactive Hierarchical Edges (McTavish) demonstrated a working model that describes a general technique to support graph analysis and visualisation particularly for student materials through the use of a process of clustering data for analysis, 'interactive hierarchical edges'. A demonstration showed how an interactive hybrid of Circos plots (a visualisation technique) with hierarchical edge bundling on an e-book could indicate knowledge areas providing a means of highlighting prerequisites knowledge at the various levels throughout the book, call out important objectives and reveal deficiencies in the content.

Discussion of the McTavish presentation and demonstration highlighted a tool that could not only be used in the context of a subject specific text book, but could be applied more broadly in the context of unit/subject or even course content. The ability to accurately map the content connections would be a valuable tool for teachers, administrators and executives. To be able to see where the content connections lie and where there is knowledge gaps or more critically no connection to the content would enable a curriculum designer to troubleshoot the issue with a quick diagnosis of the areas that may require attention.

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<sup>3</sup> Lynch, C. The first International Workshop on: Graph-based Educational Datamining (G-EDM) EDM-2014, 2014

## 6. THE INTERNATIONAL EXPERIENCE

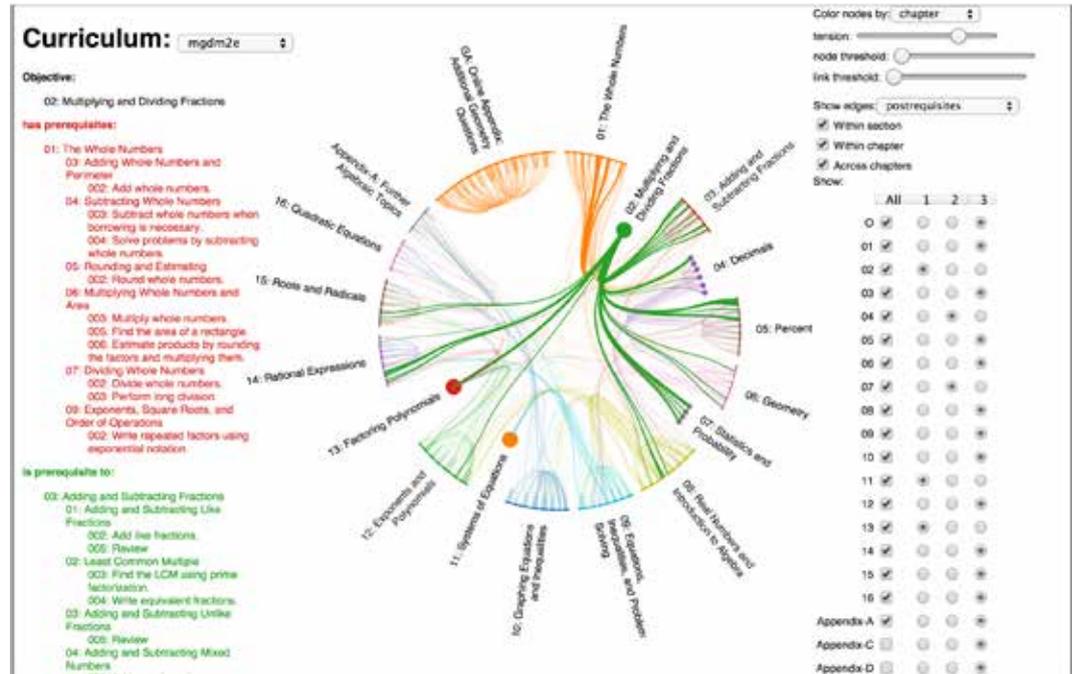


Figure 1. McTavish 2014, Screen shot of the interactive, hierarchical edge bundling graph.

### EDM – Plenary Session

The opening plenary at the conference was by Dr Joseph Beck from the Worcester Polytechnic Institute Worcester, MA, USA. Dr Beck took the attendees on an exploration of where education data mining was and where it he thought it should be going. The Education Data Mining (EDM) community arose seven years ago out of the artificial intelligence in education community in the US. He noted that there had been a significant evolution and growth in the EDM community since that time culminating in the number of papers and presentations put forward for the conference along with the number of delegates that were attending.

Dr Beck broke down what he saw as the main focus that the EDM community to be working towards into two areas:

1. EDM and Teachers/Academics
2. EDM and Information Technology Services (ITS).

Each of these areas has different needs and requirements from the community. While each need to be addressed as distinct interest groups for the community, commonalities must be recognised and



## 6. THE INTERNATIONAL EXPERIENCE

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discussed, as the end goal of their needs coincide. The idea for the community was that the, “Use and collection of educational data must improve learning and be acceptable to other agents”.<sup>4</sup>

Dr Beck (2014) noted that the EDM community should be speaking more openly with teaching academics in order to provide them with useful interventions and analytics, while working towards receiving more qualitative feedback on what investigations are viable in assisting with pedagogies used by teachers.

In collaborating more closely with the Information Technology Services (ITS) groups of an organisation or institute, those from within the EDM community could work towards providing modelling expertise, that would then in turn assist ITS to achieve its specific agreed goals around data collection and collation.

There were many notable presentations in the keynotes, the poster sessions and the general presentations. For example:

- Daniel M. Russell from Google who discussed ‘MOOCs, students and learning’ based on a course that had over 150 thousand participants worldwide and was run by Google the previous year. The discussion raised some interesting points about data and usage with the following by-line mentioned at the end of the talk, “Remember there are real students with real lives behind those data streams”.<sup>5</sup>
- Zoran Popovic from the Center of Game Science at the University of Washington, in his keynote addressed the ‘Generative Adaptivity for Optimization of the Learning Ecosystem’. His interest is in games and gaming and he talked on how ‘A lesson is a sequence of micro activities’ (or games) for the entire class.

### Site visits

#### The Open University UK

Part of the Fellowship program was a visit to The Open University (OU), Milton Keynes, Buckinghamshire, UK in order to engage with a variety of researchers and staff about their experiences in the learning analytics field. The OU has developed a strong connection with the Society of Learning Analytics Research (SoLAR) an inter-disciplinary network of leading international researchers who are exploring the role and impact of analytics on teaching, learning, training and development.

Learning analytics is a fast developing and strategically important area for the University. To recognise this development, it has created a new programme centred in this area through the work of an internal group, the Institute of Educational Technology (IET). The leading research at the IET in Learning Analytics makes advances in the way in which data about the learning experience is interpreted and the future behaviour of students predicted. This has significant potential to enhance the quality of the OU’s teaching, its IET profile and the University’s competitive advantage.<sup>6</sup>



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<sup>4</sup> Beck, J., The field of EDM: where we came from and where we’re going. Keynote The 7th International Conference on Educational Data Mining, London July 4-7 2014

<sup>5</sup> Russell, D., 150K+ online students at a time: How to understand what’s happening in online learning. Keynote The 7th International Conference on Educational Data Mining, London July 4-7, 2014

<sup>6</sup> The Open University UK, Learning analytics, 2014

## 6. THE INTERNATIONAL EXPERIENCE

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### Visit 1: With the Pro-Vice Chancellor (Learning and Teaching)

The initial meeting at the OU UK was with Professor Belinda Tynan, Pro-Vice Chancellor (Learning and Teaching) and Kevin Mayles, Senior Manager, Learning and Teaching.

The objective of the meeting was to discuss and learn more about the learning analytics program that has been implemented at the OU. The week prior to the visit, Tynan and Mayles made a presentation to the Transforming Assessments Group<sup>7</sup> that highlighted many of the areas that came up in the discussion. The information that was presented in the webinar fortuitously gave the Fellow valuable pre-discussion information that could be drawn upon during the discussion.

The discussion focused on the need for development of a policy and program around learning analytics, considered to be a crucial step in the development the ethical framework for learning analytics. The OU built their particular framework around eight principles that were developed following consultation with staff and students.<sup>8</sup>

The eight principles that the OU has adopted as part of the learning analytics framework are as follows:<sup>9</sup>

1. Learning analytics is a moral practice which should align with core organisational principles
2. The purpose and the boundaries regarding the use of learning analytics should be well defined and visible
3. Students should be engaged as active agents in the implementation of learning analytics
4. The OU should aim to be transparent regarding data collection and provide students with the opportunity to update their own data and consent agreements at regular intervals
5. Modelling and interventions based on analysis of data should be free from bias and aligned with appropriate theoretical and pedagogical frameworks wherever possible
6. Students are not wholly defined by their visible data or our interpretation of that data
7. Adoption of learning analytics within the OU requires broad acceptance of the values and benefits (organisational culture) and the development of appropriate skills
8. The OU has a responsibility to all stakeholders to use and extract meaning from student data for the benefit of students where feasible.

Institutes aiming to develop a framework in relation to learning analytics could use the eight principles outlined above as a basis. The OU UK were continuing to develop and refine some of the principles to ensure that they integrated effectively with their analytics framework.

### Visit 2: Mini-LASI with IET, KMI and other OU staff

The second visit to the OU occurred on a different day from the initial one and involved a group of participants drawn from different areas throughout the institute. There were members from the Institute of Educational Technology (IET) Academic Team, the Knowledge Media Institute (KMI) and some other interested parties drawn from throughout the institute.

The proceedings for the day were organised in the format of a mini-conference. A number of the group had the opportunity to attend the LASI (Learning Analytics Summer Institute) in Boston and key discussions from



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<sup>7</sup> Crisp, G & Hillier, M. Learning Analytics for large scale distance and online courses. Transforming Assessment, 2014

<sup>8</sup> Tynan, B. & Mayles, K. Learning Analytics for large scale distance and online courses, 2014

<sup>9</sup> Tynan, B. & Mayles, K. Learning Analytics for large scale distance and online courses, 2014

## 6. THE INTERNATIONAL EXPERIENCE

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this event were presented on the day. The areas that were presented and discussed were:

- Teaching related to learning design
- Informed consent around storage and access to data
- Using data for the benefit of the students
- Currency in the available datasets
- Quality enhancement seminars and talking to end users on data
- Modules/Subjects performing beyond expectations
- Not to use gathered data in punitive measures against staff
- Qualitative data vs quantitative data
- Learning Analytics community exchange
- Assessment and feedback through OpenEssayist.



There was a practical demonstration of the OU student support tool in tandem with a discussion on the use of 'OU Analyse' (a system developed at OU for use by academics and support staff to analyse student interaction with the LMS) for student success. A key message was that the effort going into understanding the pathways and mechanisms of student knowledge gain had the tangible and valuable result of enabling and directing the provision of stronger feedback and support for the students. The staff supporting the students through interacting with these systems would also be in a better position to understanding the student pathways to learning and knowledge gain, which ultimately would

contribute to retention of students in the study program to graduation.

The discussion on the assessment feedback through the OU developed application OpenEssayist, which is designed to present summaries of the students written work in order to encourage the student to reflect constructively on what they had written<sup>10</sup> provided further information into the application that could assist students with written discourse. One of the biggest challenges to the researchers in putting together this system was to develop appropriate responses to the findings on the analysis of the student submitted work.<sup>11</sup> There was considerable discussion within the development team that the system developed should provide meaningful automatic feedback that was seen as non-judgemental and did not end in creating a digital disconnect between the student and the system response.

The Fellow presented to the group the four key areas of the Fellowship program of study. This stimulated valuable discussion using the group's collective knowledge in the learning analytics field to breakdown and provide feedback on the paper. The presentation was a revised version of that presented at STLHE in June 2014.

The main discussion points focussed on the extent of the work of the Fellowship. The participants felt that the areas that the Fellowship addressed was quite broad and would require a team of people to achieve. There was comment that the OU had a number of different teams of people working on

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<sup>10</sup> Van Labeke, Nicolas; Whitelock, Denise; Field, Debora; Pulman, Stephen and Richardson, John T. E. OpenEssayist: extractive summarisation and formative assessment of free-text essays. In: 1st International Workshop on Discourse-Centric Learning Analytics, 8 Apr 2013, Leuven, Belgium, 2013.

<sup>11</sup> Whitelock, D. LASI day at OU. Presentation at The Open University 2014: with Denise Whitelock from The Open University, 2014

## 6. THE INTERNATIONAL EXPERIENCE

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various aspects of learning analytics to provide solutions to the Institute and it was noted that the team that the Fellow was working with was much smaller. Therefore in order to alleviate any potential frustration that may arise by not achieving all the goals, it would be prudent to focus on a smaller subset of achievable targets.

# 7. KNOWLEDGE TRANSFER: APPLYING THE OUTCOMES

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Boyd and Brack are adopting the following approach to the dissemination of the findings and application of outcomes of the Fellowship.

Dissemination of findings:

- Internal presentations - to working groups, committees
- External presentations - seminars, working groups and discussion papers.

Application of outcomes:

- Internal strategic directions - advice and knowledge transfer in the area of potential policies and procedures
- Learning design
- Professional development for staff

## Dissemination - Internal Presentations

Presentation to and discussions with the e-learning team at Melbourne Polytechnic have facilitated immediate and tangible impacts on the Fellowship findings. For example, aspects of the research have been incorporated into the planning for training and site design. While there is a broad understanding of how the use of learning analytics can enhance both the delivery and organisational aspects of the working group, the findings of the Fellowship provide a catalyst for further developments within the immediate working group.

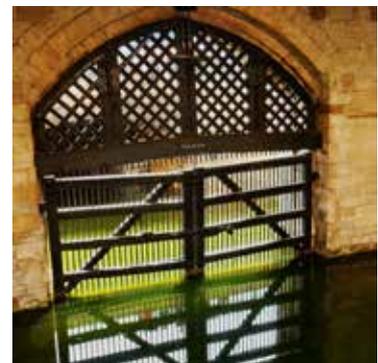
Presentations across the Institute are aimed at raising awareness of the benefits of learning analytics among stakeholders in the following categories:

- Institute Board
- Institute Executive
- Senior Management
- Academic staff
- Administrative staff

Each of these groups have particular needs in the area of learning analytics from a strategic institute view, to a broad departmental approach, across a program area, to a micro view inside a particular unit or course. Awareness at multiple levels in the organisation is necessary for the distributed leadership required to support the use of educational technologies effectively.

Key vehicles for transfer of knowledge have been via presentation, reporting and discussion at executive and management levels:

- Programs Advisory Committee (PAC)
- Systems Sub-Committee.



## 7. KNOWLEDGE TRANSFER: APPLYING THE OUTCOMES

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Presentations at learning forums include:

- Higher Education Learning and Teaching Showcase (12/12/2014)
- Professional Development secondments (2015).

### Dissemination - External Presentations



A number of external presentations and discussions will be held as soon as possible to ensure that the knowledge gained is disseminated as widely as possible across the TAFE network. See Recommendation 5 in Section 9 for details.

### Applications – Internal strategic directions

To leverage the value of learning analytics at an institutional level, the development of a strategic approach is required. This includes the creation of policies and procedures pertaining to the use of learning analytics at a vocational institution. Knowledge gained through the Fellowship will inform such a strategic approach.

The use of learning analytics for adaptive learning will be explored through learning design projects in collaboration with teachers. This will enable the teaching staff to better understand how their online content and learning activities are being used by the students. They would then be able to use this information to improve and update the learning designs of their subjects and units.

The use of learning analytics by teachers using dashboard technologies and including graphic visualisation to increase efficiencies in learning and reporting will be included in the staff professional development program. Sessions for course administrators will be included to facilitate the reporting lines through to the student administration system.

The Fellowship program focussed on skills and knowledge in the following areas:

1. Record and investigate sources of data relevant to learning and teaching
2. Strategically and systematically analyse data
3. Bridging the gap for teachers - dashboard technologies
4. Using dashboard technologies – exemplars.

The overseas studies responded to each of these areas to varying extents revealing perspectives on which to base key recommendations.

The Fellows will use their knowledge gained throughout the Fellowship program to work more openly with the academic staff in order to provide them with useful interventions and analytics, while also working towards receiving more qualitative feedback on what investigations are viable in assisting with their pedagogies.

Efforts have already and will continue to focus on small number of achievable and practical goals.

## 8. RECOMMENDATIONS

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### Overview

In his opening comments at the Educational Data Mining (EDM) conference, Joseph Beck said the, “Use and collection of educational data must improve learning and be acceptable to other agents”.<sup>1</sup> This aligns with and underpins a number of the tangible goals of the Fellowship program:

1. Supporting the development of learning analytics at NMIT/Melbourne Polytechnic
2. Developing expertise in the design and implementation of tools to facilitate the use of learning analytics by teachers to improve learning design
3. Share findings across the training and education sector broadly.

The development of a strong knowledge base of the types of study that has occurred in the Learning Analytics (LA) and the Education Data Mining (EDM) communities are at the forefront of realising these goals.



### Key recommendations

1. Plan for participation of staff and students through dissemination and staff professional development.
2. Develop a policy and program around learning analytics which includes an ethical framework for learning analytics.
3. Develop a prototype for data visualisation using Circos plots focussing on a smaller subset of achievable targets.
4. Strengthen automatic feedback and support for students through model approaches.
5. Dissemination beyond the institution to learning and teaching communities and tertiary education forums nationally.

### Specific Recommendations

#### Supporting the development of learning analytics at Melbourne Polytechnic.

The recommendations and support of this initiative relates broadly to the Fellows addressing the skills enhancement 1 and 2.

#### Recommendation 1

*Develop a plan for participation of staff and students through dissemination and staff professional development, in order to raise awareness, gain support and cooperation, contributing to the effective use of data to enhance student learning.*

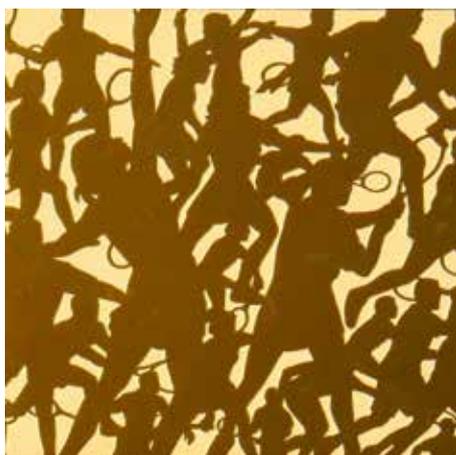
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<sup>1</sup> Beck, J. (2014) The field of EDM: where we came from and where we're going. Keynote The 7th International Conference on Educational Data Mining, London July 4-7, 2014

## 8. RECOMMENDATIONS

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### Recommendation 2



*Develop a policy and program around learning analytics which includes an ethical framework.*

Development of learning analytics at the institute requires appreciation and understanding from a broad range of stakeholders from students through to the Board. The dimensions of learning analytics that must be addressed include: data ownership and ethical issues, retrieval and analysis, mechanisms for enhancing learning and teaching. The approach is to raise awareness through information dissemination at multiple levels and through the development of policy, frameworks, guidelines and standards.

*Developing a broad understanding of learning analytics at Melbourne Polytechnic*

Design and provision of a subset of standard data derived information would assist academics in the learning design. The ability to tailor some of the knowledge gained from the data, to their particular subject area is crucial in making that knowledge applicable and acceptable.

Inclusion of the student community within a broad context of the use of data has the potential to contribute to both ethical and learning design issues. The focus of the EDM community was in the investigation of the particular micro details occurring in a program of study, with no apparent reference to knowledge gain for student through learning enhancement, yet the inherent strength of using the analytics is in the ability to send clear yet distinctive goals to the students through the use of this information. This is in contrast with the more broad-based approach that has been the focus of the work at OU. The OU is looking for an integrated approach that specifically addresses student interactions across a whole unit of study. It is crucial for the understanding of the data and what it means, to include both the micro approach characterised in the EDM community, and the more macro approach at the OU.

### **Institute Presentation Sessions**

Dissemination of findings of the fellowship within the institute commenced within a month of returning from the overseas study tour. The initial presentation was at a Teaching and Learning seminar for the Higher Education program area. The topic of this seminar was "Travelling with Analytics" and it described the complete fellowship program including, but not limited to, the aims, actual events undertaken, type of outcomes that the fellow was aiming to achieve and the initial findings from the program. Questions and discussion during and after the presentation indicated a low level of understanding of how using the data collected in learning management systems could be used effectively by the academic staff in the support of student learning. There was agreement that a greater understanding on this would impact positively on the teaching experience and would more importantly have a positive flow-on effect to the student learning and engagement.

Uptake and integration of a strategic approach to learning analytics requires distributed leadership, so it is crucial that staff at all levels of the organisation gain an understanding and appreciation of learning analytics and the benefits for enhancement of learning and teaching. Dissemination to senior managers has occurred via presentations and reports to governance and operational committees.

## 8. RECOMMENDATIONS

### Institute Workshops

A plan of how to effectively use the information gained through the fellowship will be addressed through a number of key workshops aimed at differing levels of the Institute structure. These levels in the Institute are readily identifiable in the “who benefits?” column from the table below.<sup>2</sup>

Type of Analytics	Level or Object of Analysis	Who Benefits?
Learning Analytics	Course level: social networks, conceptual development, discourse analysis, “intelligent curriculum”	Learners, faculty
	Departmental: predictive modelling, patterns of success/failure	Learners, faculty
Academic Analytics	Institutional: learner profiles, performance of academics, knowledge flow	Administrators, funders, marketing
	Regional (state/provincial): comparisons between systems	Funders, administrators
	National and International	National Governments, education authorities

Boyd and Brack have planned to target specific workshops to learners, faculty staff, administrators and management (those who provide financial support). The initial focus is for the various levels in the institute to develop a stronger understanding of the concept of learning analytics and how it can be broadly approached within each of their working areas.

### Developing a policy framework

Ethical issues include questions of who owns the data?, who has access to data?, how is data used?, how is data secured? Acceptance among academics and students of the collection of the data depends on the answer to these questions. A framework for learning analytics must address these issues and make the use of learning analytics to enhance learning transparent.

The eight principles that the OU recommend and follow will be adopted as part of the learning analytics framework to provide a sound basis for policy development.<sup>3</sup>

Policy development will commence at Melbourne Polytechnic in 2015.



<sup>2</sup> Seimens, G. and Long, P. (2011), Penetrating the Fog, EDUCAUSE Review, vol. 46, no. 5

<sup>3</sup> Tynan, B. & Mayles, K. (2014) Learning Analytics for large scale distance and online courses, 2014

## 8. RECOMMENDATIONS

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Developing expertise in the design and implementation of tools to facilitate the use of learning analytics by teachers to improve learning design.

### Recommendation 3

*Develop a prototype for data visualisation using Circos plots focussing on a smaller subset of achievable targets.*

#### Visualisation of data

The presentation at the EDM conference from McTavish<sup>4</sup> provided a good starting point in determining the relevant data sources from visual representations of data. Circos plot diagrams facilitate identification of relationships between objects or positions. In a learning analytics context this means pathways of student activity can be mapped. Content that has not been accessed by students suggests potential knowledge gaps, and learning activities that have not been completed may indicate skills gaps.

The ability to accurately map the content connections would be a valuable tool for teachers, administrators and executives to identify deficiencies in content. Understanding knowledge gaps would enable educational designers to identify potential learning impediments and troubleshoot issues with a quick diagnosis of the areas that may require attention.

This form of network analysis and its visualisation providing a useful tool to be used in the context of a subject specific text book, could also be applied more broadly in the context of unit, subject or course content.

Another more poignant use of this technology could be in the context of student learning and assessment. Student application of a Circos plot to an assessment item could be a valuable learning tool enabling them to identify knowledge deficiencies. This could be a learning tool in the manner of the current text matching applications.

### Recommendation 4

*Strengthen automatic feedback and support for students through model approaches.*

#### Feedback to students

There has been considerable discussion within the Melbourne Polytechnic development team that the systems used should provide meaningful automated feedback that is seen as non-judgemental and does not result in creating a digital disconnect between the student and the system response.

## Share findings across the training and education sector broadly.

### Recommendation 5

*Dissemination should occur beyond the institution to learning and teaching communities and tertiary education forums nationally. There should be ongoing engagement with the field of learning analytics.*

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<sup>4</sup> McTavish, T. Facilitating Graph Interpretation via Interactive Hierarchical Edges, EDM-2014 Conference Papers, 2014.

## 8. RECOMMENDATIONS

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### **External Presentations – (NB: two of three recommendations completed)**

The external presentation of the outcomes of the fellowship followed a similar dissemination plan to that of the institute. There are a number of small specialists groups that sit outside the organisation but are suitable groups that would benefit from the knowledge gained from the program. Those areas targeted in the initial presentation of the information (completed in November and December 2014) were:

- eWorks TAFE Advisory Group (TAG) - This a group of 10 TAFE representatives from the eWorks client base. They are advisers to the eWorks management on the usability of the currently employed e-learning system
- The Mixed Sector Symposium from The Group of 5 (Go5) Network, (the five Victorian TAFE Institutes offering Higher Education degrees). Box Hill Institute, Chisholm, Holmesglen, Melbourne Polytechnic and William Angliss.
- An overview report will also be made through our collaboration with the Klevar Group (<http://klevar.com/>).

Boyd presented selected findings to the eWorks TAG in late November 2014 as part of the last meeting for the year. This information dissemination fitted in well to one of the current TAG projects. The group had been looking at an advanced reporting and analytics module as an additional feature for the current LMS platform. The particular project is set to enhance the reporting and analytical capability of the training virtual campus (TVCplus) platform to meet a range of requirements, with a specific initial focus on being able to provide accurate and timely information on students for a variety of institutional requirements in a number of formats.

Throughout the development stage of the advanced reporting and analytics project the TAG group has focused quite extensively on the compliance with a lesser focus on the learning analytical capabilities of such system. This is an understandable focus of the current project as many of the TAFE institutes are required to be more compliance orientated via various government policies which in turn will then naturally fall to the focus more closely representing the compliance requirements of the reporting. The perceived benefits of the learning analytics in assisting both the teacher and the student in the learning environment are at this stage not as much of a focus.



The Mixed Sector Symposium presentation occurred in early December 2014, at Box Hill Institute as part of the 3rd annual symposium for the five Victorian TAFEs that are delivering higher education programs. This symposium is a day that includes concurrent sessions focusing on the challenges, opportunities, practicalities and philosophies of higher education in TAFE and concluding with a keynote address by Andrew Norton.

Boyd presented a session to the symposium participants on the subject of the original fellowship application Using learning analytics to improve online learning design.

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# 10. ATTACHMENTS

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## Appendix 1: Three Conference Proposal

The two conferences were also to be tied in with a third conference, the Learning Analytics Summer Institute conference to be held in Europe. However, the Fellow could not accommodate late re-scheduling of the conference location (changed from Madrid to Boston), which occurred after all other travel itinerary had been confirmed and booked. While this set back proved to be a little frustrating to the Fellow it was unfortunately an unavoidable outcome from the initial proposal.

## Appendix 2:

### **CON10.07– Analytics and Online Learning at an Australian Tertiary Education Institute**

#### **Paper and Presentation by Shaun Boyd (Northern Melbourne Institute of TAFE)**

We have used a systematic approach of the use of a Virtual Learning Environment (VLE), managed at an institutional level, to transform learning and teaching experiences at an Australian tertiary education institute. Through an analysis of systems data analytics, we studied access to and use of the VLE by diverse cohorts of students over time.

Northern Melbourne Institute of Technical and Further Education (Melbourne Polytechnic) has a long history of vocational education and training (VET) with large student cohorts, and more recently offered higher education (HE) courses with small but rapidly growing student numbers. The Institute has an integrated approach to the diverse student cohorts with a focus on providing pathways to further study and support for transition in particular from VET into HE courses. Online engagement is an important strategy in our blended learning and teaching approach and in achieving integration.

We will describe the implementation of the VLE in three stages. In 2011-2012, we introduced online learning and teaching using our VLE (Moodle) in all HE subjects using a model of prototyping and piloting, template development, and implementation (stage 1). In December, 2012, we evaluated the status of online learning and teaching in VET (stage 2) to provide a starting point for the same model for design and development initiated in 2013 across selected VET courses (stage 3). Professional development for staff (teachers, administrators) at multiple levels and support for students, included strategically timed structured (e.g. workshops) and unstructured (e.g. one-to-one on demand) support.

We will present simple analytics indicating access (Google analytics) and use (Moodle learning analytics) of the VLE at each stage and consider trends over time. Use was categorised as: basic (transmission of content); intermediate (transmission, self-directed learning); or advanced (transmission, collaboration replacing face-to-face learning). We are specifically interested in the social constructivist aspects offered by online learning and the engagement of learners and teachers. We compare VLE use by cohorts of students to identify effective strategies for diverse contexts. Analysis of systems data should help to design more effective and efficient online learning and teaching environments, and further tailor learning for individuals. We will discuss benefits and limitations in the data collected and its analysis in our context. We will describe aspects of the project and discuss their importance in terms of engagement with technology and satisfaction of stakeholders.

