Systemic Implementation of Learning Analytics in Higher Education
- Challenges and Directions -

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Hong Kong
Learning analytics can offer many benefits, right?!
Learning analytics topics

- Student behavior and outcomes
- Assessment
- MOOCs
- Social Network Analysis
- Data Mining techniques
- Video Analysis
- LA frameworks
- Concept learning
- Web analytics
- Learning interactions
- Group-based problem solving
- Access pattern analysis
- Feedback
- Predictive analytics
- LA field
- Log data analysis
- LA adoption challenges
- Collaborative learning
- Implementation reports
- Discussion interventions
- LA visualizations

Proportion of annual publications

Publication year

2012 2014 2016
Learning analytics topics
INSTITUTIONAL ADOPTION: CURRENT STATE
Very few institution-wide examples of adoption
Current state – Oz and Europe

http://he-analytics.com

http://sheilaproject.eu/
Sophistication model

Sophistication model

Adoption of Learning Analytics in Higher Education: 
State, Challenges, and Policies

- Executive Summary -

1. Context

There is a growing interest in learning analytics among higher education institutions in the UK and other countries. However, the maturity levels of higher education institutions in terms of being ‘student data informed’ are only at early stages. Studies have shown that most institutions are still in a preparatory or early stage of adoption, i.e. showing awareness of analytics and using some basic reports. To assist European universities to become more mature users and custodians of digital data collected from students during online learning activities, the SHEILA project, funded by European Commission via the Erasmus + program, aims to build a policy development framework that promotes formative assessment and personalised learning by taking advantage of direct engagement with stakeholders in the development process. The first phase of the SHEILA project is to map out the state of learning analytics in higher education and identify emerging challenges by engaging with relevant empirical studies. Another major task in this phase is to interrogate existing learning analytics policies to identify gaps to address and lessons to learn. For these purposes, a systematic literature review was conducted and the results are summarised below. The full report is available upon request.

2. Methodology

The search of relevant literature was carried out in four stages between June and July 2016. The first stage involved key-word searches (“learning analytics” and “policy or policies”) on various databases and journals that were known for substantial collections of studies in the fields of learning analytics, social sciences and computer science. The main topics considered included ethics and privacy, policies, institutional strategies, institutional readiness, and institutional capacities. 23 empirical studies were eventually selected, and reviewed thoroughly in addition to 8 existing policies for learning analytics that were identified.
Adoption challenge

Leadership for strategic implementation & monitoring
Solution-driven approach

Bought an analytics product.

Analytics box ticked!
Lack of data-informed decision making culture

LA idealized systems model

Adoption challenge

Equal engagement with different stakeholders
Adoption challenge

Training opportunities to use learning analytics
Adoption challenge

Policies for learning analytics practice
Adoption challenge

Monitoring impact and learning from the use
What’s necessary to move forward?
Data – Model – Transformation

DATA – MODEL – TRANSFORMATION
Types of data sources

Data – Model – Transformation

Online interactions and trace data

Types of data sources

Data – Model – Transformation

Online interactions and trace data
Data about extracurricular activities

Types of data sources

Data – Model – Transformation

Online interactions and trace data
Data about extracurricular activities
Socio-economic and demographic variables

The Data Flow

1 - Data are gathered from a variety of systems
2 - Data are normalized and modeled in a central repository
3 - Success metrics and risk scores are delivered via reports, dashboards and CRM integration

Data – Model – Transformation

Necessary IT support

Data – Model – Transformation

Necessary IT support
Creative data sourcing

Engagement beyond LMS

http://www.beyondlms.org/
Interaction via social media predicts performance

Student discourse as feedback for teaching

Virtual economies also exist in life simulation games such as The Sims Online, or Second Life, which has perhaps taken the most radical steps toward linking a virtual economy with the real world, such as recognizing IP rights for assets created "in-world" by Second Life subscribers, and maintaining a laissez faire policy on the buying and selling of Linden Dollars (the world's official currency) for real money on 3rd party websites. They can even exist in browser-based internet games like Neopets, Tokenzone or Kings of Loathing where "real" money can be spent and user-created opened, or in other games as a kind of Emergent gameplay.
Social networks are everywhere

Learning design as the driver

Awareness of limitations and challenging assumptions

Collaboration and open source technologies
Open Learning Analytics: an integrated & modularized platform
Proposal to design, implement and evaluate an open platform
to integrate heterogeneous learning analytics techniques

George Siemens & Dragan Gasevic
Athabasca University, Canada

Caroline Haythornthwaite & Shane Dawson
University of British Columbia, Canada

Simon Buckingham Shum & Rebecca Ferguson
The Open University, United Kingdom

Erik Duval & Katrien Verbort
Katholieke Universiteit Leuven, Belgium

Ryan S. J. d. Baker
Worcester Polytechnic Institute, United States

July 28, 2011

Apereo Learning Analytics Strategic Vision
An Open Learning Analytics Platform

Learning Activities Collection – Standards-based data capture from any potential source using open standards: xAPI and/or IMS Caliper/Sensor API.

Storage – Single repository for all learning-related data using Learning Record Store (LRS) standard. Over the past year OpenLRS has made significant progress toward maturity. In addition to its support of the Experience API (xAPI), OpenLRS has added support for the IMS Caliper learning event specification. OpenLRS has also seen its first production deployment at the University of Notre Dame. Several additional production deployments are planned for 2016 at both higher education institutions and global publishers.

Analysis – Flexible Learning Analytics Processor (LAP) that can prototype data mining, data processing (ETL), predictive model scoring and reporting. Work on larger datasets is handled by Apache Hadoop and Apache Spark.

Communication – Dashboard technology for displaying LAP output.

Action – LAP output can be fed into other systems to trigger alerts, etc.

Apereo members are building software around this platform. OpenLRS, Learning Analytics Processor, OpenDashboard and Student Success Plan are early examples of the benefits of a platform-based approach.

https://www.apereo.org/communities/learning-analytics-initiative
What data sources are important for your institution?

What is the current IT support for data use/integration in your institution?

How should IT support learning analytics in your institution?
DATA – MODEL – TRANSFORMATION
Data – Model – Transformation

Learning context

Academic success prediction

Linear and logistic regression
Multilevel linear modeling
Classification algorithms
Learning context

Understanding of learning

Unsupervised data mining
Social network analysis
Text and discourse analysis
Sequence and process mining
Data – Model – Transformation

Question-driven, not data-driven

HAVING CONDUCTED A COMPREHENSIVE ANALYSIS OF DOZENS OF SUBSETS OF DATA FROM A WIDE RANGE OF SOURCES WE'VE CONFIRMED THAT THE LIKELY ANSWER IS 36....NOW WE JUST NEED TO IDENTIFY THE QUESTION!
Data – Model – Transformation

Question-driven, not data-driven

Theory-informed learning analytics

Learning analytics is about learning

One size fits all does not work in learning analytics
Learning context

Instructional conditions shape learning analytics results

Regression analysis and classification
Multilevel nature of data
Learner agency

Students are not the same

Recursive partitioning technique

Learner agency

More time online does not always mean better learning

Unsupervised methods

Learner profiles – use of LMS

Large effect sizes (1.4-2.5 σ) on critical thinking and academic success

Learner agency

Learners are not black boxes and change study strategy

Sequence mining

Strategy use on a weekly basis

Effects of analytics depend on institutional context

Open Academic Analytics Initiative (OAAI)

The Innovation: The Open Academic Analytics Initiative (OAAI)

Early detection of at-risk students can trigger proactive support to help students get past roadblocks and stay on a path to academic success. The OAAI offers an open-source solution that identifies at-risk students through predictive analytics. The model applies data mining techniques to a large set of student demographic and aptitude data as well as event logs and gradebook data stored in the Sakai learning management system (LMS).

http://nextgenlearning.org/grantee/marist-college
Data science

Organizations specialized in learning analytics

Availability of features (segments)
Similarity of participants (clusters)
Separate regression for each segment-cluster
Predictive analytics can reinforce biases if used carelessly

Data mining for discrimination discovery
Explainable vs. unethical discrimination

Algorithmic accountability for learning analytics
What questions are of importance for your institution?

Which analysis methods are relevant?
DATA – MODEL – TRANSFORMATION
Data – Model – Transformation

Participatory design of analytics tools

Very little methods for and examples of participatory design
How to provide feedback relevant to learning design?

Activity-centred design model

Learning design as key driver

Closing the loop

1. Explore teaching problems and analytics solutions

Interviews with 12 teaching academics (4 from each participating institution)

- Pedagogical intent
- Educational technologies
- Educational problems/situations
- Needs and wants
Closing the loop

1. Explore teaching problems and analytics solutions

Interviews with 12 teaching academics (4 from each participating institution)

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<th>Discipline</th>
<th>Year level</th>
<th>Class size</th>
<th>Digital resources</th>
<th>Discussion board</th>
<th>Lecture capture</th>
<th>Online quizzes</th>
<th>Turnitin</th>
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Closing the loop

Interviews with 12 teaching academics (4 from each participating institution)

1. Fairly basic analytics requests
2. Focus on engagement analytics
3. Limited use of technological tools (blended)
4. Concerns over ability to interpret data
5. Concerns over time taken to interpret and act upon the data

Closing the loop

Closing the loop

1. Explore teaching problems and analytics solutions

2. Development of a web-based analytics tool
   - Web-based tool
   - Extract data from Moodle/Blackboard
   - Pedagogical intent, technological tools & data
# Pedagogical Helper Tool

## Learning Objectives, Learning Activities and Learning Resources Mapper

### Learning Objective

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<td>Induction Declarative Questions</td>
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<tr>
<td>Anatomy Pracs, ADSL (course/x-bb-coursetc)</td>
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### Learning Activity

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### Learning Resource

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### Save
Pedagogical Helper Tool

Learning Resource Selector

- Announcements (resource/x-bb-announcement)
- View Gradebook (course/x-bb-gradebook)
- blank (Mobile Content View)
- blank (/webapps/blackboard/content/manageFolder.jsp)
- blank (Mobile Content View)
- Physiology Practical: Week 11 (course/x-bb-coursedoc)
- Special Consideration (course/x-bb-coursedoc)
- Staff Information (resource/x-bb-stafffolder)
- divider_1311593363901 (course/x-bb-coursedoc)
- Pharmacology SDL (course/x-bb-coursedoc)
- Anatomy Pracs, ADSL (course/x-bb-coursedoc)
- Anatomy Pract Induction (course/x-bb-coursedoc)
- divider_1311593320562 (course/x-bb-coursedoc)
- Assessment (course/x-bb-coursedoc)
- Handbook Link (course/x-bb-coursedoc)
- My Grades (course/x-bb-gradebook)
- Lecture Capture (course/x-bb-coursedoc)
- PRS Clickers (course/x-bb-coursedoc)
- Timetables (course/x-bb-coursedoc)

Selected Resource: None

Select
### Top Site Visitors

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### Assessment Access

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Expand all | Collapse all
Title: --TOP--
Type: resource/x-bb-folder

Pageviews

Zoom 1m 3m 6m YTD 1y All

Quiz: Start Date

Quiz: End Date

Update Based On Date Selection

Student Pageviews Histogram
### Students with no views

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**Search:**
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### Course Communication

**Repeating Course Events:** Lecture (Tuesday)  
**Update**

**Note:** Blue indicates the forum was viewed before the selected event, and Red after the event. The size of the circle is related to the number of posts; larger circles indicate higher number of posts.

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Data – Model – Transformation

Analytics tools for non-statistics experts

Visualizations can be harmful
Why analytics must be visualizations?

Students don’t perceive dashboards as feedback

User-centered design methods

Generative card sorting exercises
Semi-structured interviews
Directed storytelling
Speed Dating sessions

So, shall we develop or buy a learning analytics product?

Reasons to develop new (1/2)

No one else is doing what you plan to do it
You need to do it
Reasons to develop new (2/2)

You can do it (have institutional capacity)
No ethical/privacy solution matches your needs
Reasons to develop new (1/2)

Existing tools met your needs
Timing does not allow for tool development
Reasons to develop new (2/2)

On-campus development resources do not exist
Existing tool matches your ethical/privacy criteria
Data – Model – Transformation

Analytics tools for non-statistics experts
Develop capabilities to exploit (big) data

You don’t have to be a data scientist to be data savvy. And that’s a good thing.

Many companies are putting massive focus on recruiting the rare beasts that are data scientists. But in doing so, they often forget the need for creating a much more data savvy culture overall.

Data is already becoming ubiquitous in business as well as in daily life. It used to be that the IT department could be contained to its own office or floor, but today, it’s becoming harder and harder to segregate the realm of data from any other aspect of business.

That means that data — and the application and analysis of said data — is going to become more and more important in every department, from sales to HR and from R&D to marketing.

The good news is that you don’t have to know how to code or do advanced maths to become data-savvy. In fact, you don’t have to be particularly tech savvy at all. What you do have to do is adopt a data-friendly mindset.

Whether you are looking to lead the way as a data-savvy employee, or lead the charge for culture change as a manager or C-level executive, here are...
Data – Model – Transformation

Analytics tools for non-statistics experts
Develop capabilities to exploit (big) data
Be prepared to act on analytics insight

Business as usual does not work with learning analytics.
Who are key stakeholders for learning analytics in your institution?

How would you involve relevant stakeholders in your institution?
An institutional learning analytics vision

IMPLEMENTATION PERSPECTIVES
65 interviews
52 institutions
12 countries
Interview topics (1/2)

Learning analytics projects and their goals
Institutional learning analytics strategy
Progress and achieved goals
Interview topics (2/2)

Challenges
Ethics and privacy
LA projects and goals

Exploratory objectives

Sense of uncertainty
What can learning analytics do for our institution?
What can our data tell us?
LA projects and goals

Very often LA projects related to research only
LA projects and goals

Diversity of interest (1/2)

UK: correlation between behavioural patterns and learning outcomes
LA projects and goals

Diversity of interest (2/2)

Spain: support teachers and improve their performance
Baltics: improve students retention
Learning analytics strategy

Growing interest of institutional leaders
Learning analytics strategy

Learning analytics part of a wider strategy

In some countries (e.g., UK, Latvia, Finland)
Learning analytics strategy

No strategy but rather a bottom up approach

In some countries (e.g., UK, Latvia, Finland)
Achievements with analytics (1/2)

Often, only in early days of implementation
Analytics is considered useful
Awareness of analytics
Achievements with analytics (2/2)

Better understanding of challenges
Improvement of data culture
In-house software is typically used, while vendors offer dashboards or systems to detect drop-out
Challenges

Cultural barriers

Data-driven and not question-driven
Traditional institutional culture
Lack of awareness
Lack of data culture
Challenges

Lack of technical experience

Readiness of a data management infrastructure
How to deal with online environments
Challenges

Human resources

Lack of time
Priorities
Ethics and privacy

Remain as a challenge

Not all of them understand it as a problem (Estonia)
Clear need of ethical guidelines and solutions
Ethics and privacy

Privacy laws are very diverse

Germany and Austria are much more restrictive than the UK or Estonia
Ethics and privacy

Ethical issues open technical problems

Very difficult to avoid processing data of one specific student if they do not allow it
LEARNING ANALYTICS
POLICY AND STRATEGY
Policy development framework

Used by different higher education institutions
Recognizes institution specific drivers
Promotes learning analytics for formative assessment

http://sheilaproject.eu/
Project activities

Literature review
Adoption of Learning Analytics in Higher Education: State, Challenges, and Policies

- Executive Summary -

1. Context

There is a growing interest in learning analytics among higher education institutions in the UK and other countries. However, the maturity levels of higher education institutions in terms of being ‘student data informed’ are only at early stages. Studies have shown that most institutions are still in a preparatory or early stage of adoption, i.e. showing awareness of analytics and using some basic reports. To assist European universities to become more mature users and custodians of digital data collected from students during online learning activities, the SHEILA project, funded by European Commission via the Erasmus + program, aims to build a policy development framework that promotes formative assessment and personalised learning by taking advantage of direct engagement with stakeholders in the development process. The first phase of the SHEILA project is to map out the state of learning analytics in higher education and identify emerging challenges by engaging with relevant empirical studies. Another major task in this phase is to interrogate existing learning analytics policies to identify gaps to address and lessons to learn. For these purposes, a systematic literature review was conducted and the results are summarised below. The full report is available upon request.

2. Methodology

The search of relevant literature was carried out in four stages between June and July 2016. The first stage involved key-word searches (“learning analytics” and “policy or policies”) on various databases and journals that were known for substantial collections of studies in the fields of learning analytics, social sciences and computer science. The main topics considered included ethics and privacy, policies, institutional strategies, institutional readiness, and institutional capacities. 23 empirical studies were eventually selected, and reviewed thoroughly in addition to 8 existing policies for learning analytics that were identified.
Project activities

Literature review

Interviews with decision makers
Project activities

Literature review
Interviews with decision makers
Group concept mapping with experts
Group Concept Mapping

Phase 1:
Brainstorming

Phase 2:
Sorting

Phase 3:
Rating

An essential feature of a higher education
Cluster Replay Map

Number of Clusters: 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2
Cluster Replay Map

At Cluster 11 merged: 7 8
At Cluster 10 merged: 11 12
At Cluster 9 merged: 1 2
At Cluster 8 merged: 5 6

Number of Clusters: 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2

Loop
At Cluster 11 merged: 7 8
At Cluster 10 merged: 11 12
At Cluster 9 merged: 1 2
At Cluster 8 merged: 5 6
At Cluster 7 merged: 10 11 12
At Cluster 6 merged: 3 4
Cluster Map

1. Privacy & Transparency
2. Roles & Responsibilities (of all stakeholders)
3. Objectives of LA (learner and teacher support)
4. Risks & Challenges
5. Data Management
6. Research & Data Analysis
Rating Map – Importance

1. privacy & transparency
2. roles & responsibilities (of all stakeholders)
3. objectives of LA (learner and teacher support)
4. risks & challenges
5. data management
6. research & data analysis
Rating Map – Ease

1. privacy & transparency
2. roles & responsibilities (of all stakeholders)
3. objectives of LA (learner and teacher support)
4. risks & challenges
5. data management
6. research & data analysis

Cluster Legend

Layer    Value
1        3.79 to 4.12
2        4.12 to 4.45
3        4.45 to 4.78
4        4.78 to 5.11
5        5.11 to 5.44
Go Zone – Privacy & Transparency

$r = 0.45$
Go Zone – Privacy & Transparency

2. transparency, i.e. clearly informing students of how their data is collected, used and protected.

$r = 0.45$

ease

importance
Go Zone – Privacy & Transparency

88. a clear description of data protection measures taken

$r = 0.45$

importance

ease
Go Zone – Privacy & Transparency

10. a clear description of data usage

r = 0.45

importance

ease

Go Zone – Privacy & Transparency

10. a clear description of data usage

r = 0.45

importance

ease

Go Zone – Privacy & Transparency

10. a clear description of data usage

r = 0.45

importance

ease

Go Zone – Privacy & Transparency

10. a clear description of data usage

r = 0.45

importance

ease
Go Zone – Privacy & Transparency

17. being clear about the purpose for collection certain types of data

$r = 0.45$
Go Zone – Privacy & Transparency

24. aligned with data protection regulations (institutional, national, international)
Go Zone – Privacy & Transparency

34. to assure that the collected data is used only for the purpose of improving learning and instruction
96. an agreement between learners, teachers and policy makers on regulating a proper use of data
Go Zone – Roles & Responsibilities

55. being clear about the purpose of learning analytics

$r = 0.26$
61. A clear articulation of roles and responsibilities when it comes to the use of institutional data.
Go Zone – Roles & Responsibilities

39. to promote broad adoption of learning analytics by specifying supportive regulations and case law
Go Zone – Objectives of LA

\[ r = -0.12 \]
Go Zone – Objectives of LA

63. to use learning analytics for improving the quality of teaching

$r = -0.12$
Go Zone – Objectives of LA

58. to allow for proactive behavior of students towards their education, with setting personal goals

$r = -0.12$
Go Zone – Objectives of LA

44. to support learners learning to learn and improve skills

$r = -0.12$
98. to encourage meaningful relationships between students
Go Zone – Risks & Challenges

![Scatter plot diagram](image)

- **Ease** vs. **Importance**
- Correlation coefficient: $r = 0.52$
Go Zone – Risks & Challenges

90. to draw attention to what the "big picture" end goal of the data use is
Go Zone – Risks & Challenges

59. to demarcate clearly between different uses of analytics in institutional settings

r = 0.52
Go Zone – Risks & Challenges

95. to ensure the benefits to students outweigh the risks
Go Zone – Risks & Challenges

53. to ensure adequate representation during high-stakes decision processes
18. integrated with a reward system for the use of evidence-based improvements to teaching and learning
Go Zone – Risks & Challenges

41. to discourage students and faculty from gaming the system
23. to define clear rules for collaboration with other researchers
57. to assure that instructional interventions are based on well-studied and empirically validated analytical methods and algorithms.
75. to encourage the development of dashboards with meaningful and understandable outcomes

Go Zone – Research & Data Analysis
68. to recognise the limitations of learning analytics
72. to provide clear examples of how to interpret data, especially when there may be interactions
81. to (re)evaluate continuously the analytics being applied
54. to enhance the connection between the academic and the society and industry, showing what is being done at the institutions is related to the education and training
21. to make explicit maths from innovative development / use of analytics in individual classrooms to scaling up
FINAL REMARKS
Rhetoric of simplistic technological fixes is unproductive
Embracing complexity of educational systems
Capacity development

Multidisciplinary teams in institutions critical
Learning analytics is more than technology and measurement
Business as usual doesn’t work

Need for approaches to removing issues identified with analytics
Development of analytics culture and capacity

Thank you!

http://sheilaproject.eu/

http://lak17.solaresearch.org/

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