Information technology — learning, education, and training — Learning Analytics Interoperability — Part 1: Reference model

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/IEC JTC 1, Information technology Subcommittee SC36, Information technology for learning, education and training.

ISO/IEC 20748 consists of the following parts, under the general title Information technology for learning, education and training —learning analytics interoperability:

- Part 1: Reference model
- Part 2: System requirements (under development)
- Part 3: Guideline for data interoperability (under development)
- Part 4: Privacy and data protection (under development)
0. Introduction

The increasing amount of data being generated from learning environments provides new opportunities to support learning, education and training (LET) in a number of new ways through learning analytics. Learning analytics is a composite concept built around the use of diverse sub-technologies, workflows, and practices and applied to a wide range of different purposes. For instance, learning analytics is being used to collect, explore and analyze diverse types and interrelationships of data such as learner interaction data related to usage of digital resources, teaching and learning activity logs, learning outcomes and structured data about programs, curriculum and associated competencies.

Learning analytics is an emerging technology addressing a diverse group of stakeholders and covering a wide range of applications. Learning analytics raises new interoperability challenges related to data sharing; privacy, trust and control of data; quality of service, etc. Through use case collection in the ad-hoc group on learning analytics interoperability, established under SC 36 in 2014, the following issues were identified and captured as general requirements for Learning Analytics applications:

For the learner

- tracking learning activities and progression
- tracking emotion, motivation, and learning-readiness
- early detection of learner's personal needs and preferences
- improved feedback from analyzing activities and assessments
- early detection of learner non-performance (mobilizing remediation)
- personalized learning path and/or resources (recommendation)

For the teacher

- tracking learners/group activities and progression
- adaptive teacher response to observed learner’s needs and behavior
- early detection of learner disengagement (mobilizing relevant support actions)
- increasing the range of activities that can be used for assessing performance
- visualization of learning outcomes and activities for individuals and groups
- providing evidence to help teacher improve the design of the learning experience and resources

For the institution

- tracking class/group activities and results
- quality assurance monitoring
- providing evidence to support the design of the learning environment
- providing evidence to support improved retention strategies
- support for course planning

In addition, learning analytics practice can build upon prior work in LET standardization and innovation but there are several factors that require special attention, and indicate a requirement to ISO/IEC 20748. These factors include:

- requirements arising from the analytical process;
- data items required to drive operational LET systems are not always the same as desired for learning analytics;
- volume, velocity, and variety of the data collected for analytics indicate different IT architectures, which imply different interoperability requirements;
- use of learner data for analytics introduces a range of ethical and other socio-cultural issues beyond those which arise from exchanging data between operational systems.

Therefore, this part of ISO/IEC 20748 gives a conceptual description of the behavior of components related to learning analytics interoperability. In particular, this technical report specifies terms as well as proposes a reference model for the learning analytics process and interoperability.
Information technology for learning, education, and training — Learning analytics interoperability — Part 1: Reference model

1. Scope

ISO/IEC 20748-1 specifies a reference model that identifies diverse IT system requirements of learning analytics interoperability. The reference model identifies relevant terminology, user requirements, workflow, and a reference architecture for learning analytics.

2. Terms and definitions

There are no normative references in this document.

3. Terms and definitions

For purposes of this document, the following terms and definitions are provided to assist in specifying the domain of learning analytics interoperability.

3.1 accessibility
usability of a product, service, environment or facility by an individual with the widest range of capabilities

Note 1 to entry: Although “accessibility” typically addresses users who have a disability, the concept is not limited to disability issues

[SOURCE: ISO/IEC 24751-1]

3.2 assessment
means of measuring or evaluating learner understanding or competency

3.3 dashboard
user interface based on predetermined reports, indicators and data fields, upon which the end user can apply filters and graphical display methods to answer predetermined business questions and which is suited to regular use with minimal training


3.4 data analysis
systematic investigation of the data and their flow in a real or planned system

Note 1 to entry: data analysis: term and definition standardized by ISO/IEC [ISO/IEC 2382-20:1990].

Note 2 to entry: 20.02.08 (2382)


3.5 data collection
process of bringing data together from one or more points for use in a computer

Note 1 to entry: Example: To collect transactions generated at branch offices by a data network for use at a computer center.

Note 3 to entry: 06.02.08 (2382)

3.6 data exchange
storing, accessing, transferring, and archiving of data

3.7 data flow
movement of data through the active parts of a data processing system in the course of the performance of specific work

3.8 data format
arrangement of data in a file or stream.

3.9 data source
functional unit that provides data for transmission


Note 2 to entry: 09.01.03 (2382)

3.10 individual
human being, i.e. a natural person, who acts as a distinct indivisible entity or is considered as such

Note 1 to entry: Adapted from ISO/IEC 15944-1:2002, 3.28.

3.11 learning analytics
measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs

3.12 learning platform
integrated set of (online) services that provide learner, teacher and/or others involved in learning, education and training with information, tools and resources to support and enhance educational delivery and management

3.13 learning outcome
what a person is expected to know, understand or be able to do at the end of a training programme, course or module

3.14 usability
extent to which a product can be used by specified users to achieve specified goals, with effectiveness, efficiency and satisfaction, in a specified context of use


3.15 workflow
depiction of the actual sequence of the operations or actions taken in a process

Note 1 to entry: a workflow reflects the successive decisions and activities in the performance of a process.

4. Symbols and abbreviated terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ADL</td>
<td>Advanced Distributed Learning</td>
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<tr>
<td>AFA</td>
<td>Access-for-All</td>
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<tr>
<td>API</td>
<td>Application Programming Interface</td>
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<td>ICT</td>
<td>Information and Communication Technologies</td>
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<td>IMS</td>
<td>IMS Global Learning Consortium</td>
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<td>LET</td>
<td>Learning, Education, and Training</td>
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<td>LMS</td>
<td>Learning Management System</td>
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<tr>
<td>LOD</td>
<td>Linked and Open Data</td>
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<tr>
<td>PLE</td>
<td>Personal Learning Environment</td>
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<tr>
<td>VLE</td>
<td>Virtual Learning Environment</td>
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<tr>
<td>xAPI</td>
<td>Experience API</td>
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5. Use cases and practices

Use cases were collected from national bodies and liaison organizations (NBLOs) of ISO/IEC JTC1/SC36. The use cases illustrate key functionalities related to learning analytics by focusing on particular requirements that stakeholders may have and then outlining how such requirements can be reflected to work flows for learning analytics. A total of fifteen use cases were received in 2014.

Use cases considered four main areas as below:

• Learning analytics
• Assessments
• Data flow and data exchange
• Accessibility preferences

The summary of the use cases are presented below. The complete list of the use cases is available in Annex A.

5.1 Learning analytics

A Stakeholder has previous experience with analytics dashboards available in online learning platforms (known as learning management systems (LMS) or virtual learning environments (VLE)). In general, data logs were not in a format that non-technical users could interpret, but these are now rendered (displayed) via a range of graphs, tables and other visualization forms, and custom reports designed for learners, educators, administrators and data analysts. Learners may get basic analytics from dashboards such as progress relative to the cohort average marks or engagement ratio.

A learning analytics is delivered with more advanced features, namely predictive analytics. Predictive analytics focuses on the pattern of learners’ static data (e.g. demographics; past attainment) and dynamic data (e.g. pattern of online logins; quantity of discussion posts). Once a student's trajectory is drawn (e.g. “at risk”; “high achiever”; “social learner”), timely interventions can be planned (e.g. offering extra social and academic support; presenting more challenging tasks).

Learning analytics is used to enhance the personalized learning environment (PLE). Based on learning analytics output the PLE can recommend learning pathways combined with learning content or resources. This service model enables fine-grained feedback (e.g. which concepts have been grasped and at what level), and adaptive presentation of content (e.g. not showing material that depends on the mastery of concepts that the learner is yet to acquire).

Other types of learning analytics are social network analytics and discourse analytics. Social network analysis makes visible the structures and dynamics of interpersonal networks to understand how people develop and maintain these relations (in the classroom or learning community). Discourse analytics requires the use of sophisticated technology to assess the quality of text in order to scaffold the higher-order thinking and writing skills that we seek to instill to learners.

5.2 Assessment

One of the advantages of using ICT in assessment is to improve precision in evaluating individual learning in order to provide input to (adaptive) learning systems. Learning analytics is useful for monitoring how students are going about learning and solving problems. This can be achieved by embedding learning assessments within the learning experience and analyzing process data in log files that capture every click and keystroke. It is important to note that embedded assessments do not need to be hidden assessments. Feedback and recommendations from the analytics platform can be highly motivating, showing learners where they should focus their attention and learning efforts along with highlighting their accomplishments.
5.3 Data flow and data exchange

Increasingly, many institutions are requiring interoperable data formats and exchange mechanisms that simplify the process of collecting and delivering learning data to and from digital learning environments. This is being driven by the proliferation of heterogeneous data generated from learning systems and applications. The ADL experience API™ (xAPI) and IMS Caliper Analytics™ (Caliper) are identified as potential standards applicable to stakeholders. The implication from ADL xAPI and IMS Caliper in terms of interoperability standards is that it is necessary to standardize profiles for presenting learning data as well as APIs implementing data capture.

One of the most important things in learning analytics is data control by the individual of his or her personal information (e.g., as a learner), including options such as “do not track” or “data chrono-degradability”. One of the cases describes an approach to giving the learner (or his/her parents) control over the data of that individual as a learner in a school setting. The use case follows the learner from registering at a school, to moving to another school, with interactions with the school (and through the school with suppliers of services, e.g., publishers). Other important issues with data control are privacy and identification of people through identity federation. Most use cases have similar privacy issues and this implies the privacy requirements and related technology should be a fundamental component of any learning analytics. Applying privacy requirements such as anonymization and pseudonymization should be reflected into learning analytics.

Learner activity data may be generated from a wide variety of platforms, including but not limited to web-based applications, desktop computers, mobile devices, wearable technologies and the internet of things. These tracking data may be used in portfolio services. As described learning analytics in 5.1, diverse types of learning data can be reflected for each learner's learning activity and progress. The portfolio service is not limited to curating and showcasing learner’s output, but also to diagnosis of strengths or weaknesses in learning contexts. Many portfolio services focus on the display of learner content and self-reflection by learners. However, improved portfolio services, based on learning analytics, will show multidimensional perspectives of learner performance and activity data.

5.4 Accessibility preferences

Dashboards provide a general way to present analytics information. This category of use cases describes how a dashboard should be presented flexibly and filtered by purposes. One of the use cases introduces scenarios for users (e.g. learner, teacher and module manager) with accessibility needs and preferences. Learning analytics enables teachers or administrators to deliver effective learning with accessibility needs being met, supported by data generated from the learning analytics. An example is supporting the needs of a learner with a vision-impairment through resources that have proven to be highly effective with learners with similar needs.

Another scenario related to accessibility is focused on early detection via learning analytics, supporting diagnostic testing for impairments, such as visual or hearing impairments, Auditory Processing Disorder (APD), Dyscalculia or Dyspraxia; and provide remediation or support. Accessibility preferences may be stored in the cloud to deliver seamless service across diverse devices.

1 Broadly defined, the Experience API (xAPI) lets applications share data about human performance. More precisely, xAPI lets you capture (big) data on human performance, along with associated instructional content or performance context information. (source: ADL, https://www.adlnet.gov/adl-research/performance-tracking-analysis/experience-api).

2 IMS Caliper establishes a means for consistently capturing and presenting measures of learning activity, which will enable more efficient development of learning analytics features in learning environments. (source: IMS Global, http://www.imsglobal.org/activity/caliperram)
6. Reference model for learning analytics interoperability

In this clause, a preliminary reference model for learning analytics is introduced by detailing the set of processes and relationships between them that is formulated from the collected use cases provided in Annex A.

A workflow of general data analytics is presented below in clause 6.1. The general data analytics workflow is extended and transformed into a loop by adding teaching and learning activities to the workflow as noted in clause 6.2. As well, additional details regarding the key elements of the reference architecture are provided in the sub-clauses of 6.2.

6.1 Workflow for general data analytics

The goal of learning analytics is to understand and improve learning and its environment and encompasses the tasks of measurement, collection, analysis and reporting of data about learners and the learning, education, and training (LET) contexts in which learning occurs. These tasks closely match the workflow of data analytics as shown in Figure 1. Such correspondence is not coincidental but suggests that learning analytics can take advantage of the technological advancement of data analytics in building a learning analytics framework.

![Figure 1. Workflows for general data analytics](image)

6.2 Reference architecture derived from workflow and use cases

There are a total of six processes in the learning analytics workflow that are supported by the Privacy and Data Protection requirements as noted in Figure 2 below. Although learning analytics is primarily based on data collection and analysis, learning and teaching activities within LET contexts are fundamental to the whole process and need to be considered in order for a feedback loop to be enabled. Learning and teaching activities provide sources for data collection and subsequent processes of the learning analytics workflow.

![Figure 2. Abstract workflow of Learning Analytics](image)
A description of each of the six processes that comprise the learning analytics workflow (Figure 2) is provided below.

- **Learning and Teaching Activity**: the process of data modeling sources of learning activities in order to decide upon learning activity data that could be used for analytics, and the release of learning activity data for Data Collection

- **Data Collection**: the process of gathering and measuring information on variables of interest in the learning and teaching activities

- **Data Processing and Storing**: the process of preparing and storing data from diverse and heterogeneous data sources for interoperable data analysis by utilizing the standardized data model and representation.

- **Analyzing**: the process of systematic investigation of learning data by inspecting, and modeling the learning data with the goal of producing descriptive and possibly predictive knowledge

- **Visualization**: the process of creating representations of abstract data including text and schematic representations such as social diagrams and maps to allow stakeholders to see, explore, interact, and understand large amounts of information in analyzing and reasoning about data and evidence

- **Feedback and Recommendation**: the process for serving the results of a cycle of learning analysis back to the learners and their contexts so that corrective actions can be taken

As illustrated in Figure 3 below, input data items can be obtained from a variety of learning and teaching activities. As well, the outputs from the learning analytics workflow can provide feedback and recommendations to inform improvements to learning and teaching activities.

![Figure 3. Reference workflow of Learning Analytics](image-url)
For each of the six learning analytics workflow processes, the sub clauses below provide more detailed information as to how requirements identified from the use cases can be met and implemented. This includes the use of mandatory actions, general considerations and optional actions. These specific processes must not be considered as fully indicative or prescriptive, as new stakeholders’ needs may result in adjustment and addition of actions.

### 6.2.1 Learning and teaching activity process

Learning & teaching activity within LET contexts is the starting point for learning analytics, and learning activities are the source of Data Collection process. In general, learning activity is performed within heterogeneous environments, using a mixture of tools. The Learning and Teaching Activity process regulates either data release as well as data modeling or profiling to be able to generate learning activity data, which can be used for analytics. Possible flows of data among Learning and Teaching Activity and Data Collection process involve the following aspects:

- Data modeling is guided by pedagogical questions outlining what aspect of learning should be supported by learning analytics, e.g., learning outcome, learning progress and attitude, student retention, development of specific cognitive skills, etc.

- When the required data sources are identified, issues related to the release of the data are addressed. These issues may include consent from the data subject, e.g., the learner, conditions for release given by data protection and privacy laws, etc. – issues described in Privacy and Data Protection requirements (Figure 2).

![Figure 4. Zoom-in diagram for Learning and Teaching Activity](image)

### 6.2.2 Data collection process

Data collection is the process of gathering and measuring information on variables of interest in learning and teaching activities as shown in Figure 5. In this process some features, such as authority and control of data source, interoperability of data, and efficiency of flow and exchange, are required for a system to work.
Possible flows of data among Data Collection and Data Storing & Processing process involve the following aspects:

- Learning and teaching activities and related data sources such as learning devices, software applications, and social networks produce various data. The sources include lectures, learning materials, learning tools, quizzes and assessments, discussion forums, messages, social networks, homework, prior credit, achievements, system logs, sensors, etc. These learning data need to be collected or converted to data API specifications such as Experience API™ (xAPI), and IMS Caliper Analytics™ (Caliper).

- The data collected from LET activities, which contains information about learners, is subject to privacy protection requirements. Here it is important that those collecting such information about learners do so with the informed consent of the learner (or its parent or legal guardian). Further, the personal data shall only be used for the goal agreed to and must be protected by necessary means such as encryption, de-identification, chrono-degradability, pseudomization and anonymization.

- Data collection APIs yield data collection instances, possibly via secured data transmission.

- Data collection processes may be subject to conformance testing or conversion prior to storing data in the temporary data store, such as the event store in IMS Caliper or learning record store in xAPI, to be used in later processing.

![Figure 5. Zoom-in diagram for Data Collection](image)

6.2.3 Data storing & processing process

Data storing and processing is the process of preparing and storing data from diverse and heterogeneous data sources for interoperable data analysis by utilizing the standardized data model and representation as shown in Figure 6. Possible flows of data among Data Storing & Processing and Analyzing process involve the following aspects:

- The learning data stored in Temporary Data Store are processed by the Data Translator and Filter. The processed results are stored into Analytics Data Store.
• The data translator and filter process may have a Unified Data Translator that translates various data in heterogeneous representations into a uniform representation, such as Linked and Open Data (LOD), by applying explicit translation rules, for an efficient and interoperable analysis process.

• A general-purpose Data Filter may be applied to the translation process driven by the Filtering Conditions to clean and transform the data.

• One of the main sources of data includes discourse, writing, conversation, and communicative events. Such data may need to be processed by Natural Language Processing before the results are in turn translated into a uniform representation.

• The data stored in Temporary Data Store may be accessed via a standardized Data Query interface, and the processed data may be stored to Analytics Data Store via a standardized Data Migration.

Figure 6. Zoom-in diagram for Data Storing and Processing

6.2.4 Analyzing process

Analyzing is the process of systematic investigation of learning data by inspecting, and modeling the learning data with the goal of producing descriptive and possibly predictive knowledge as shown in Figure 7. Possible flows of data among Analyzing and Visualization process involve the following aspects:

• As well as the Micro Data stored in the Analytics Data Store, general domain data such as curricula, learning resources, and preferences may be stored in Constant Information to be utilized by the Data Analysis.

• Privacy concerns exist wherever information about learners (or other sensitive information) is collected and stored. Learning data analysis is not an exception.

• Various external analysis algorithms such predictive analytics, adaptive analytics, learning disabilities, discourse analytics, and other assessments using ICT are applied via Analysis Interface.

• Analysis Processing may consist of statistical analysis, topic analysis, network analysis, and social analysis as the low-level front-end analysis. The results of low-level analysis then may feed into pattern learning, dynamic modeling, and association analysis before they are used by dashboard integration, content recommendation, and learning path recommendation.
• The analysis results may be refined by the Data Manipulation interface and then stored into the Analytics Data Store for further analysis cycles or later processing steps such as the visualization process.

Figure 7. Zoom-in diagram for Analyzing

6.2.5 Visualization process

As mentioned in Section 6.2, visualization is the process of creating representation of abstract data including text and geographic information to allow users to see, explore, interact, and understand large amounts of information in analyzing and reasoning about data and evidence as shown in Figure 8. A primary goal of visualization is to communicate information clearly and efficiently to users via the statistical graphics, plots, information graphics, tables, and charts selected, and thus makes complex data more accessible, understandable and usable. Possible flows of data among Visualization and Feedback process involve the following aspects:

• The data in Analytics Data Store may be accessed by the visualization process via Data Query interface

• Visual representation for learning analytics may include dashboard information, ePortfolio, social diagrams, Learning Path & Resources.

• The dashboard information may show comparisons or progress, recommendations, and real-time assessments, topic-based assessment, social-network graph, etc.

• Data Interface may provide an open data interface to the external dashboard and reporting system to provide feedback information such as personalization, intervention or prediction for individual users
6.2.6 Feedback process

Feedback Actions serve the results of a cycle of learning analysis back to the learners and their contexts so that corrective actions can be taken. The feedback process of LA is concerned with mediation of the knowledge gleaned from the data. Not only are learners on the receiving end but also course designers, developers of learning materials, teachers and administrators, etc. are party to learning analytics. Possible flows of data from Learning & Teaching Activity to Feedback process involve the following aspects:

- For feedback action to learners or other stakeholders data set analyzed needs to be flowed from reporting system using open data interface.

- Statistical information can be used as feedback action to control pace of learning, change attitude or pattern, compare with peer group, or recognize position of themselves within social diagrams.

- Feedback action based on prediction may be applied for learners, teachers and other stakeholders. For instance, learner trajectories using captured learning data can be used to identify learners at-risk, high achievers, or social learners.

- Feedback actions enable adaptive learning environments, which may provide non-linear pathways pertaining to personalized digital resources, content or self-assessment.
Figure 9. Zoom-in diagram for Feedback
Annex A
(informative)

Use Cases and Practices

Use cases in this clause illustrate key functionalities related to learning analytics by focusing on particular requirements that stakeholders may have and then outlining how such requirements can be reflected to work flows for learning analytics.

A.1 Learning analytics

- **Use Case I-01. Analytics dashboards on LMS/VLE**

<table>
<thead>
<tr>
<th>Contributor (name)</th>
<th>Yong-Sang Cho (<a href="mailto:zzosang@keris.or.kr">zzosang@keris.or.kr</a>) and Jing DU (<a href="mailto:dujing@tsinghua.edu.cn">dujing@tsinghua.edu.cn</a>)</th>
</tr>
</thead>
</table>
2. KERIS report (written in Korean): [http://goo.gl/CgPLGu](http://goo.gl/CgPLGu)
3. Learning Analysis Dashboard in MOOC and SPOC: [http://www.xuetangx.com](http://www.xuetangx.com) |
| Main stakeholders | For learner and teacher |
| Description | Analytics dashboards are found in most online learning platforms known as learning management system (LMS) or virtual-learning platform (VLE). In general, data logs were not in a format that non-technical users could interpret, but these are now rendered (displayed) via a range of graphs, tables and other visualization forms, and custom reports designed for learners, educators, administrators and data analysts. Currently, learning platforms record data logs related to engagement of learners such as login time and count of logins, number of participations in discussion forums, and whether assignments are completed or not. More advanced analytics platforms will integrate data from other learning platforms, software and content (See this case in use case III-01).

Learners may get basic analytics from dashboards such as progress relative to the cohort average marks, and how level of engagement in learning activity designed by the teacher. Some institutions are going further, and add information using visualization products to assist interpretation of complex data extracted from a student information system and school information system.

LMS/VLE vendors provide examples and webinars about their analytics dashboards, and the enterprise analytics vendors are contextualizing their products to the education market. A very useful compendium of higher-education case studies is being compiled by EDUCAUSE, e.g. Arizona State University reports that it is seeing returns on its investment in academic and learning analytics, including a “Student 360” program that integrates all that the institution knows about a student.

| Notes and/or Issues | Even if LMS/VLE just use its log data (without third party's logs) related to student's activity to display dashboards, the data should be approved or agreed by student and don't be used for other purposes that did not agree with service license agreement (SLA) between vendor/institution and student. There are two different ways (opt-in and opt-out) to gather privacy information generated through learning activity such as messages, content on forum, log-in time, area, device and count, etc. |
## Use Case I-02. Predictive Analytics using trajectory data

<table>
<thead>
<tr>
<th>Contributor (name)</th>
<th>Yong-Sang Cho (<a href="mailto:zzosang@keris.or.kr">zzosang@keris.or.kr</a>)</th>
</tr>
</thead>
</table>
2. KERIS report (written in Korean): [http://goo.gl/CgPLGu](http://goo.gl/CgPLGu) |
| Main stakeholders | For learner, teacher and parent |
| Description | Predictive analytics focuses on the pattern of learners' static data (e.g. demographics; past attainment) and dynamic data (e.g. pattern of online logins; quantity of discussion posts). Once a student's trajectory is drawn (e.g. "at risk"; "high achiever"; "social learner"), timely interventions can be planned (e.g. offering extra social and academic support; presenting more challenging tasks). Currently, one of the most reliable predictors of final exam results is still exam performance at the start of studies. The design of more complex data-driven predictive models must clearly improve on this, but require statistical analysis to identify those variables in the data that can be historically validated as being the strongest predictors of 'success'. While at present these are most commonly defined as assignment/exam outcomes, the debate about assessment regimes (see below) draws attention to the role that analytics could play in providing formative feedback and the building of horizontal/transferable skills.  

Work at Purdue University on the Course Signals software is well known, and the technology is available as a product. Signals provides a red/amber/green light to students on their progress. Their most-recent evaluation reports: “Results thus far show that students who have engaged with Course Signals have higher average grades and seek out help resources at a higher rate than other students.” University of Michigan report promising results with physics students from their E2Coach infrastructure which adapts personalized (open source) intervention technology from validated health informatics research, to give customized feedback and motivate students to change their strategies. Paul Smith’s college used Starfish EarlyAlert to integrate staff feedback on students, and Rapid Insight tools to build an accurate predictive model for identifying at-risk students.  

Models may be context-specific to the particular institution, culture, level of study, discipline, etc., or (most excitingly) may prove robust enough for general use. The Predictive Analytics Reporting (PAR) Framework, developed and piloted with six US educational institutions, seeks to identify patterns in their collective student data. Initial results report a significant correlation between disenrollment and the number of concurrent courses in which students were enrolled. These approaches are designed for generic learning environments, agnostic to subject matter, but if one constrains the scope to a specific topic, new kinds of analytics are possible. |
| Notes and/or Issues | There are same issues described in use case I-01.  
In particular, prior to getting trajectory data institution and vender should notice what kind of data they will gather and how they will push the alert to the student via a SLA. In this case it seems opt-in appropriate for the service. |
Use Case I-03. Personalized learning environments with digital resources

<table>
<thead>
<tr>
<th>Contributor (name)</th>
<th>Yong-Sang Cho (<a href="mailto:zzosang@keris.or.kr">zzosang@keris.or.kr</a>)</th>
</tr>
</thead>
</table>
| Source (name or url) | 1. UNESCO Policy Brief: http://iite.unesco.org/publications/3214711/  
2. KERIS report (written in Korean): http://goo.gl/CgPLGu  
| Main stakeholders | For learner and parent |
| Description | Web-based learning platforms are migrating to mobile environments. Both can provide learning environments for the delivery of personalized learning paths accompanied by appropriate content and resources. Personalized paths can be built using a model of a learner’s understanding of a specific topic (e.g. algebra; photosynthesis; dental surgical procedures), sometimes in the context of standardized tests which dictate the curriculum and modes of testing. This enables fine-grained feedback (e.g. which concepts have been grasped and at what level), and adaptive presentation of content (e.g. not showing material that depends on having mastered concepts the learner has failed on). Naturally, dynamic modeling of learner cognition, and preparation of material for adaptive content engines, are far more resource-intensive to design and build than conventional ‘dumb’ learning platforms.

To accurately match resources to curriculum is a critical factor for an adaptive content engine. For this purpose, linked data for the curriculum standard in terms of a competency map is essential to link resources with the curriculum. The match between resources and curriculum standards can be based on analytics of the learner’s competency level.

Significant research and investment in intelligent tutoring systems and adaptive hypermedia are bringing web platforms to market with a high-quality user experience, and this is likely to continue to be a growth area. Examples include the free Open Learning Initiative courses based on Carnegie Mellon University’s research, and commercial services such as Grockit and Knewton (http://www.knewton.com/)

ASN (Achievement Standards Network) Framework is a good example to make curriculum standards to linked (open) data, and to connect digital resource according to subject-by-subject, in terms of competency level, on curriculum standards. |
| Notes and/or Issues | There are same issues described in use case I-01. In this level of analytics service specialized analysis engine and/or platform, which is independent from LMS/VLE, is required. This scenario raises some questions how do student's identify such as PII (Personally Identifiable Information) transmit in secured way between LMS/VLE and analytics platform, and how student can control to permit or prohibit their data use, etc.

Furthermore, this scenario has assumption to combine heterogeneous technology (or service); analytics and linked data for curriculum standards and digital resources. Use case III-02 and III-05 describe more detail for this issue. |
**Use Case I-04. Social network analytics**

<table>
<thead>
<tr>
<th>Contributor (name)</th>
<th>Yong-Sang Cho (<a href="mailto:zzosang@keris.or.kr">zzosang@keris.or.kr</a>)</th>
</tr>
</thead>
</table>
2. KERIS report (written in Korean): [http://goo.gl/CgPLGu](http://goo.gl/CgPLGu) |
| Main stakeholders | For learner and teacher |
| Description | Social network analysis — sometimes called Organizational Network Analysis in corporate settings — makes visible the structures and dynamics of interpersonal networks to understand how people develop and maintain these relations. People may form "ties" of different sorts, ranging from extended, direct interaction reflecting significant ties, to more indirect ties. Research is beginning to demonstrate that the connections learners forge among them, and the resulting group structures, can correlate with effective learning.

Recently social network analytics is also used to understand common interest and hot topics (by cohort group) in the society. The key words are very fast changes within social networks in real time. Through counting numbers of key words and tracking pattern for changing we may understand how people feel on specific issues or topics or people's emotional (or cognitional) changes in the timeline. In other words, social network analysis is useful for not only people's networking growing/managing but also topic trends within people.

"Enterprise 2.0" products can be used to identify the most active users in an online network, and those who are likely to have most influence on the activity of others. There are numerous free tools for interactive visualization and analysis of networks. One tool specifically designed for learning network is SNAPP which renders discussion forum postings as a network diagram to help trace the growth of a cohort, identify disconnected students, or visualize how teacher support is employed within the network. Another is NAT, designed to help teachers see their offline social networks, which annotates social ties with the relevant topics. |
| Notes and/or Issues | There are same issues described in use case I-01.
In particular, to make anonymous for identifiable messages of persons is mandatorily required because social network analysis is just for capturing trends in one way. |
• **Use Case I-05. Discourse analytics**

<table>
<thead>
<tr>
<th>Contributor (name)</th>
<th>Yong-Sang Cho (<a href="mailto:zzosang@keris.or.kr">zzosang@keris.or.kr</a>)</th>
</tr>
</thead>
</table>
2. KERIS report (written in Korean): [http://goo.gl/CgPLGu](http://goo.gl/CgPLGu) |
| Main stakeholders | For learner and teacher |
| Description | A learning platform might record how many times a learner has executed basic actions such as logging in, viewing a forum and posting a message. This is the level at which most actual analytics products operate. However, analytics needs to go beyond simple quantitative logs, to provide feedback to educators and learners on the quality of the interaction. Researchers are beginning to draw on extensive prior work on how tutors mark essays and discussion posts, how spoken and written dialogues shape learning, and how computers can recognize good argumentation, in order to design analytics that can assess the quality of text, with the ultimate goal of scaffolding the higher-order thinking and writing that we seek to instill to students.

This scenario can be extended to machine learning system through the analytics. The learning system in terms of machine can be improved through experiences and learning how teacher and student correct and/or improve their sentences to achieve goal of the learning. Then the learning system can be involved to analysis discourse appropriately.

While still at the stage of research prototypes, discourse analytics is specifically tuned for learning or sense making in content. There are numerous open-source research platforms and enterprise grade products capable of analyzing written and spoken natural language to assist computational reasoning, but they have not been designed with learning specifically in mind. As such, they represent raw technologies with intriguing possibilities for learning analytics researchers to conceptualize to education. |
| Notes and/or Issues | This use case seems to long-term project and may be related to more wide issues than described above. |
## A.2 Assessment

- **Use Case II-01. Changing assessment through the learning analytics**

<table>
<thead>
<tr>
<th>Contributor (name)</th>
<th>Yong-Sang Cho (<a href="mailto:zzosang@keris.or.kr">zzosang@keris.or.kr</a>)</th>
</tr>
</thead>
</table>
  2. KERIS report (written in Korean): [http://goo.gl/CgPLGu](http://goo.gl/CgPLGu) |
| Main stakeholders | For learner |
| Description | Test makers are concerned about issues of reliability (consistency) and validity (measuring what they intend) of online assessments, and also about how to prevent cheating. As online programs increasingly confer certification, it is crucial that institutions can be confident that the students have actually mastered the required knowledge and abilities. The purpose of ICT based assessment is to improve precision in evaluating individual learning in order to provide input to adaptive learning systems.

Learning analytics is useful for monitoring how students are going about learning and solving problems. This can be achieved by embedding learning assessments within the learning experience and analyzing process data in log files that capture every click and keystroke. It is known in the gaming industry as “stealth assessment,” where tracking performance data is part of the game. This approach can reduce test anxiety because the lines between learning and assessment are blurred.

It is important to note that embedded assessments do not need to be hidden assessments. In fact, there are examples where providing students with the results of embedded assessments can drive greater learning and engagement. For example, the popular online game *World of Warcraft* continually assesses player progress and presents feedback to the player in the form of a heads-up display that appears on the game screen (it can be compared to a dashboard). The information is highly motivating and shows where they should focus their attention and learning efforts, so they can do better and open up new levels within the game. |
| Notes and/or Issues | There are same issues described in use case I-02. |
Use case II-02. Developmental assessment based on the learning analytics

| Contributor (name) | The Joint Laboratory for Mobile Learning. Ministry of Education- China Mobile Communications Corporation  
| Shengquan Yu (toyusq@gmail.com) |
| Source (name or url) | Learning Cell Knowledge Community: [http://lcell.bnu.edu.cn/index.jsp](http://lcell.bnu.edu.cn/index.jsp) |
| Main stakeholders | For learner |
| Description | With the advent of Web2.0, various new form digital technology (cloud computing, the semantic web, Internet things, etc.) of constantly emerging, the online learning style has also changed from the Electronic Learning to the Mobile Learning, then to the Ubiquitous Learning. Learning assessment is an integral part of any learning, while how to effectively assess the online learning effect is a concerned issue for us.  

In our case, we have adopted learning analytics assessments basing on learning activity that can gather process data on how students are allocating time to study, making contribution to learning content, completing learning task and solving problems rather than depend on the score of end-of-unit multiple-choice test. This occurs by embedding learning assessments within the learning experience and analyzing process data in learning activities that capture processing and result information.  

In the way of data-collection, we make the learning situation information data, production data, study consumer behavior and learning result data as assessment index. Based on those data, the teacher can design assessment scheme from six aspects, such as learning attitude, learning activities, resources and tools, content interaction, evaluation feedback, and user-defined item.  

According to the assessment scheme set by the teacher, learning cell platform can automatically calculate each learner's achievement. Teacher can check every student's academic record, remind the backward students of accomplishing task on time, and adjust the corresponding teaching strategies and plans basing on the whole class situation. Students can also view their own learning status at any time, and arrange their learning process. In addition to the list of assessment feedback form, learning cell platform also provides knowledge map about students' mastery of knowledge points to teachers and learners, green means entirely master, yellow means generally master, red means poorly master.  

Up to now, we have conducted many subjects of practice; the implementation results show that this assessment pattern can promote deep learning. |
| Notes and/or Issues | The weight of each assessment item is set by the teacher to ensure that assessment is scientific. |
### A.3 Data flow and data exchange

- **Use case III-01. Learning activity data flow and data exchange**

<table>
<thead>
<tr>
<th>Contributor (name)</th>
<th>Yong-Sang Cho (<a href="mailto:zzosang@keris.or.kr">zzosang@keris.or.kr</a>)</th>
</tr>
</thead>
</table>
| **Source (name or url)** | 1. ADL Experience API (xAPI): [http://www.adlnet.gov/tla/experience-api/](http://www.adlnet.gov/tla/experience-api/)  
3. IMS Learning Analytics Project: Caliper Analytics Measurement Framework |
| **Main stakeholders** | For learner and teacher |
| **Description** | A growing number of learning interactions take place online environments based on the use of web-based content, forum and assessment on LMS/VLE, third-party software, and digital textbook, etc. However, due to supporting tools have their own data format for tracking and storing learner's data, it cause complexity of the problem to understand data. Sometime this independent data format is called “data silo” and it means for lack of interoperability related to data and exchange. For instance, data silo has been caused complexity and high costs for institutions to monitor learners' performance and assess effectiveness of their educational programs (curriculum). Therefore, many institutions have felt necessary for interoperable data format and exchange mechanism those which aim at simplifying the process of collecting and delivering learning data from digital learning environments. Related to consumption for interoperable data format, ADL experience API (xAPI) and IMS Caliper Metrics are identified as potential standards applicable to stakeholders in learning, education and training domain. According to IMS Global’s white paper there are at least sixteen types of learning activities needs to be defined as Metrics format; reading, lectures, quiz, projects, homework, media, tutoring, research, assessment, collaboration, annotation, gaming, social, messaging, scheduling and discussion. Some educators expend these sixteen types to more specific activity types. How many types of learning activity may be specified are still open issues between research and implementation level. Currently IMS Global's working group, Caliper project team has been developing basic metrics for measuring learning activity and a sensor API for capturing and reporting this data. The implication from ADL xAPI and IMS Caliper in terms of interoperability standards is there is mandatorily required to develop standards, data metrics and capturing API for data flow and data exchange specified LET domain.  

| Notes and/or Issues | There are same issues described in use case I-01, -02 and -03. In particular, IMS Global initiated Privacy Task-Force to treat privacy issues and develop guidelines. |
Use case III-02: Kennisnet Student Data Control

<table>
<thead>
<tr>
<th>Use case title</th>
<th>Kennisnet Student Data Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributor (name)</td>
<td>Tore Hoel (on behalf of LACE project, in understanding with Erwin Bomas, Kennisnet, The Netherlands)</td>
</tr>
<tr>
<td>Source (name or url)</td>
<td><a href="http://www.slideshare.net/kennisnet/privacy-by-design-mock-up-kennisnet-sxsw">http://www.slideshare.net/kennisnet/privacy-by-design-mock-up-kennisnet-sxsw</a> The slides are published under a CC-BY license</td>
</tr>
<tr>
<td>Main stakeholders</td>
<td>Parent/student; Parent; School administration; Service supplier;</td>
</tr>
</tbody>
</table>
| Description             | The use case is describing an approach to giving students (parents) control over their data in a school setting. The use case follows the student from registering at a school, to moving to another school, with interactions with the school (and through the school with suppliers of services, e.g., publishers).

These are some of the interactions outlined in this scenario:

- Parent signs up child to school
- School informs about requests for data and permissions given. As dashboard shows “who has access to my data”, sorted by category and by service. Dashboard also shows a log on what is done to different data types, e.g., grades, personal information, assignments etc.
- Dashboard shows what kind of data external services, e.g., textbook publishers, has access to (e.g., contact information); what results the service produces (e.g., grading); and what social apps the service uses
- The dashboard allows the parent to set privacy level, detailing when the school needs to ask parent’s permission to share data with 3rd party
- The school is provided with a dashboard showing permissions requests and privacy setting for cohorts
- The supplier also is provided with a dashboard showing privacy requests and status of privacy setting of the users of their products
- The platform is providing support for school – supplier interaction related to updates of privacy settings, e.g., in new products
- The parents are requested to approve use of specified data in new products that the school is planning to implement
- System allows to analyze data matching between old and new school when student is moving

This use case raises a number of standardization challenges:

- It requires a centralized authorization system governing access to information based on resource owners policies. The resources used in this scenario reside in any number of servers, both in school and in 3rd party entities (companies). So, there is a need for a privacy-driven architecture to be designed and standardized.
- There is a need to agree on a common vocabulary for permission / data types, e.g., contact information, activity information, "social emotional functioning" information, privacy level information, etc.

| Notes and/or Issues | The User Managed Access (UMA) specification developed by Kanatara initiative as a profile of OAuth 2.0—\[https://kantarainitiative.org/groups/user-managed-access-work-group/\] – is supposed to play a major role in implementing the use case described by Kennisnet. (UMA is currently an Internet-Draft, to be published as an IETF RFC) |
## Use case III-03. ePortfolio management using analytics

<table>
<thead>
<tr>
<th>Contributor (name)</th>
<th>Yong-Sang Cho (<a href="mailto:zzosang@keris.or.kr">zzosang@keris.or.kr</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main stakeholders</td>
<td>For learner, teacher and parent</td>
</tr>
<tr>
<td>Description</td>
<td>Through use case I-01 to I-05 we saw possibilities for those diverse types of learning data can be reflected for each learner’s learning activity and progress. In fact, learning activity data can be meaningful beyond analytics. Once learning analytics will be widely adopted for supporting personalized learning recommendation system or environment, and next will be an ePortfolio service. Understanding learning analytics concept at this moment, ePortfolio service may be composed of six processes; (1) collecting and storing learning activity, (2) assessment and/or real time feedback, (3) learning analytics from gathered data, (4) design for personalized learning path, (5) feedback between student, teacher and parent, (6) Improving learning system (outcome analysis). This portfolio service is not only to curate student’s output from learning activity, but also to diagnosis their gap for strengths and weaknesses on learning context. Current ePortfolio service just displays data, which was registered by student, and each learner needs to analyze for self-reflection. However, improved ePortfolio service based on learning analytics will show multidimensional perspectives for student’s performance and activity data. Also this emerging portfolio service can help self-reflection process through more wide range of data and accurate analysis.</td>
</tr>
</tbody>
</table>

### Notes and/or Issues

There are same issues described in use case I-01, -02 and -03 In particular, notes of use case III-02 is very useful guideline to this use case in terms of data control by consumers.
### Use case III-04. Learning data utilization for research activities / privacy issues and research ethics

<table>
<thead>
<tr>
<th>Contributor (name)</th>
<th>Gérard Vidal (<a href="mailto:Gerard.Vidal@ens-lyon.fr">Gerard.Vidal@ens-lyon.fr</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main stakeholders</td>
<td>Learners, ministry of higher education, researchers, teachers</td>
</tr>
<tr>
<td>Description</td>
<td>Learning Analytics activities raise broader questions on Big Data and data mining. These topics are very sensitive, particularly on the issues dealing with privacy. Access to personal data and their management is usually controlled by laws, but situations vary across countries where large social networks tend to enforce their « de facto » standards.</td>
</tr>
</tbody>
</table>


Any research use or other utilization linked with educational data mining (EDM), machine learning (ML), data collection and data mining derived from learning activities of individuals should abide shared rules and recommendations on privacy.

Applied ethic was developed when moral and social questions were raised by new professional practices enabled by technological innovation or fundamental research progress. In France, a committee is working on ethics CCNE ([http://www.ccne-ethique.fr/](http://www.ccne-ethique.fr/)). It can provide advice to government, public institutions, higher-education institutions, any non-profit research body. Its activities are mainly dealing with health and human research implying interaction with human body.

Universities and research institutions can also set up their own ethics committees like in Switzerland or Canada to deal with LA and use of personal data derived from learning activities.

Examples of best practices derived from UK Data Archive:

- taking into account the life cycle of research data
- considering data management and data sharing as being fully included in research activities
- identifying and map roles and responsibilities
- giving detailed information on data sets to enhance their re-usability
- define and select access modes to research data


- guarantee confidentiality on information given for studies,
- define data types and utilization made for each type,
- control access for research purpose, define procedures to get access to information,
- define technical conditions for data access, security schema extension to other data

| Notes and/or Issues | Some of the elements proposed might depend on law in some countries. |


- **Use case III-05. Identity protection and identification**

<table>
<thead>
<tr>
<th>Contributor (name)</th>
<th>Jaeho Lee (<a href="mailto:jaeho@uos.ac.kr">jaeho@uos.ac.kr</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source (name or url)</td>
<td>The University of Seoul, no publication</td>
</tr>
<tr>
<td>Main stakeholders</td>
<td>learner</td>
</tr>
</tbody>
</table>
| Description | Learning analytics are carried out for the data about learners and their contexts. These data are always associated with the identities of the learners or the contexts, implicitly or explicitly. For the purpose of the analysis,  
• The identities should be able to be explicitly represented and to be stored, even when they are inferred from the implicit identities,  
• A single identity may have multiple identifications depending on the context or the sensors that attach the identification. There should be a way to identify the identifications as a single identity when they should be,  
• There should be a way to map an identification that is represented in a digital form to the real identity or some associated properties of the identity, as needed.  
On the other hand, for the purpose of the protection to ensure privacy of the identity,  
• The represented form of identification alone should not allow for unauthorized person to easily guess the real identity of the identification.  
• Over the course of time, the identification should change not to enable a collection of data over time to provide enough information to reveal the identity.  
These two seemingly contradictory requirements should be balanced and be able to be administered by the policy.  
• The policy should provide appropriate levels of protections as needed.  
• The policy should be able to provide a way to change the level of protection as needed as in the cases of “importing” or “exporting” to different level of protection. |
| Notes and/or Issues | This use case is for agenda setting related to identify data source flowed from diverse environment. In general, for learning analytics interoperability people firstly focus data collecting and measuring, but to avoid ambiguous data collection, which is based on secured way for privacy protection, data identification guide is very important. |
### A.4 Accessibility preferences

- **Use Case IV-01. Learning Analytics Supporting Accessibility Enhancements**

<table>
<thead>
<tr>
<th>Contributor (name)</th>
<th>Original contributor: Tore Hoel (<a href="mailto:tore.hoel@hioa.no">tore.hoel@hioa.no</a>) Modified by Andy Heath (<a href="mailto:andyheath@axelrod.plus.com">andyheath@axelrod.plus.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source (name or url)</td>
<td><a href="http://martyncooper.wordpress.com/2012/10/12/use-case-scenarios-learning-analytics-disabled-students-accessibility/">http://martyncooper.wordpress.com/2012/10/12/use-case-scenarios-learning-analytics-disabled-students-accessibility/</a></td>
</tr>
<tr>
<td>Main stakeholders</td>
<td>For learner, for teacher or institution (choose one of the list)</td>
</tr>
<tr>
<td>Description</td>
<td>These 3 use case scenarios are adapted from Martyn Cooper’s weblog - <a href="http://martyncooper.wordpress.com/2012/10/12/use-case-scenarios-learning-analytics-disabled-students-accessibility/">http://martyncooper.wordpress.com/2012/10/12/use-case-scenarios-learning-analytics-disabled-students-accessibility/</a>. Three scenarios are presented here that were adapted from those created for a concept paper [1] for the Society for Learning Analytics Research (SoLAR – <a href="http://www.solaresearch.org">www.solaresearch.org</a>). Credit goes to Martyn’s colleagues at the Open University of UK Rebecca Ferguson and Annika Wolff for writing them. Discussion of these use case scenarios is deferred to subsequent blog posts but comments and questions on them would be most welcome.</td>
</tr>
</tbody>
</table>

- **Scenario 1**

  Kris is a student who has access to a dashboard of analytics that provides him with feedback when he is at his computer or using a mobile device. He has set the dashboard to send him a weekly summary of his activity on university sites, and on a set of external sites where he has chosen to share his data with the analytics system. He receives basic statistics on attendance, participation and marks on his formal assignments and exams. He receives personalized recommendations suggesting resources and contacts available at his location and relevant to his range of learning interests. However, what he finds most useful for reflection is the visual ‘mirrors’ that the system presents to him, plus suggestions of ways in which he might become a more effective, strategic learner.

- **Scenario 2**

  Jenny teaches one of Kris’ courses. Her dashboard is designed for educators, and can be configured to illuminate problems and progress on the course. Visualization provides an overview of the course’s social network and indicates students ‘at risk’, as defined by a range of algorithms that matches online behavior to predictive models based on past cohorts. There are different categories of risk, so Jenny can easily filter to see more details behind each student’s classification. One risk category flags students who have an identified accessibility needs and who are nearing a point in the course that previous analysis has identified as being a potential challenge area for such students with those particular needs. Kris has a visual impairment and Jenny sees that this is a good time to enquire whether he needs any additional support. She logs all contact (including the form it takes), generating data that can be used to evaluate the effectiveness of the predictive methods. Jenny has also chosen to view aggregates of all the personal Learning Analytics on her students’ dashboards, providing a deeper level of insight into how they are self-reporting and evidencing their progress.

- **Scenario 3**

  Natalie is a module manager at the OU. She is exploring statistics from a previous module presentation in order to discuss changes for the following presentation. Natalie can see from the visualization of VLE data combined with assessment data that students who performed poorly on the second assessment had engaged significantly less with quizzes than those who did well. The system flags up that a significant proportion of these students has declared accessibility needs. Natalie
compares data sets and finds a similar pattern on other modules, indicating a potential accessibility issue with the quizzes presented alongside module materials. She undertakes some follow-up activities, contacting a percentage of students from several modules with a questionnaire to try to identify the cause of the problem before passing her findings to the university’s accessibility experts for detailed evaluation and remedial action.

<table>
<thead>
<tr>
<th>Notes and/or Issues</th>
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<tbody>
<tr>
<td>All uses cases relating to user accessibility needs involve privacy issues. One question is, for what purpose the individual students declared their accessibility requirements to the university or other educational establishment, and is this consistent with how that information is to be used in the learning analytics approaches? Is it ethical to use historical or current data relating to students with accessibility needs to undertake research into future approaches of applying learning analytics? (These issues were raised, with respect to “disability” by Martyn Cooper in a blog post of Feb 2014 - <a href="http://martyncooper.wordpress.com/2014/02/17/ethics-learning-analytics-and-disability">http://martyncooper.wordpress.com/2014/02/17/ethics-learning-analytics-and-disability</a>)</td>
</tr>
</tbody>
</table>
Use Case IV-02. Early detection and of accessibility needs to support adaptation to those needs

<table>
<thead>
<tr>
<th>Contributor (name)</th>
<th>Adapted from a use case supplied by Pierre-Julien Guay</th>
</tr>
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<tbody>
<tr>
<td>Source (name or url)</td>
<td>GTN-Quebec, Quebec college network</td>
</tr>
<tr>
<td>Main stakeholders</td>
<td>For learner</td>
</tr>
<tr>
<td>Description</td>
<td>Some legislatures currently provide accessibility support for learners organized around medical and professional assessment of the needs of those learners. In the best scenario, information about assessed needs is carried forwards throughout the learner's school and college life. If this is not possible then the student could request support or diagnostic testing from the college. Examples of impairments could include visual or hearing impairments, Auditory Processing Disorder (APD), Dyscalculia or Dyspraxia. Learning Analytics could provide early detection based on general diagnostic tests at college entrance or when undertaking specific tasks which are based on processes which are negatively impacted by these impairments.</td>
</tr>
<tr>
<td>Notes and/or Issues</td>
<td>This use case was caused concern from Access For All perspective. This use case was pointed like “medical model” and assumed situation such as “special needs people sit over there and normal people sit in the other corner”. This approach is the old way to deal with accessibility, it is the past not the future - and it locks in organizations and has many problems. Unfortunately some countries still do organize &quot;disability support funding&quot; around organizational structures that work that way though countries that follow the latest and best practices are moving in a different direction - an &quot;Access for All&quot; direction in which provision for all people is integrated and disability is a mismatch of provision to needs rather than a feature of the consumer.</td>
</tr>
</tbody>
</table>
- **Use Case IV-03. Accessibility preferences stored in the cloud**

<table>
<thead>
<tr>
<th>Contributor (name)</th>
<th>Andy Heath (<a href="mailto:andyheath@axelrod.plus.com">andyheath@axelrod.plus.com</a>)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source (name or url)</td>
<td>Andy Heath</td>
</tr>
<tr>
<td>Main stakeholders</td>
<td>Learners, Students and Learner-support persons</td>
</tr>
<tr>
<td>Description</td>
<td>Material in an eBook is supplied to students as part of their course. A teacher, who is familiar with a particular student’s accessibility needs uses an editor programme to make a guess at a set of accessibility preferences that she thinks will suit that learner and the editor stores these preferences in the cloud. They include preferences relating to images, videos, fonts, contrast settings, animations and assessment question delivery. This initial set of preferences is stored by the editor in a cloud storage system such as using xAPI. When the learner reads the eBook for the first time on his tablet reading device it is daylight and the initial set of preferences the teacher created are loaded and the reading device adapts its interface and the content to meet them. However the preferences don’t quite suit the learner perfectly and so he makes some small changes in the interface, increasing the contrast and making the font size slightly larger. These changes are recorded to the cloud server as they are made. Later in the day it becomes cloudy and the sky darkens. The reading device notices this and also notices that the learner’s pace of reading has slowed and the device suggests to the reader that he might like the screen contrast and brightness adjusted to help him read. The user agrees and so the device changes those settings and sends the changed settings and the environmental conditions in which they apply (light conditions in this case) to the cloud server. Next time the user reads the book on that device the appropriate settings for the environmental conditions are retrieved from the server and applied automatically. When the learner reads the book on a different device the learner is asked if he would like to start with the same preferences as on the tablet device he used earlier.</td>
</tr>
<tr>
<td>Notes and/or Issues</td>
<td>Privacy is relevant to all parts of this and can be achieved by appropriate privacy within the operating system of the device and reader (specifically in the way settings are conveyed to the reader – see <a href="https://dvcs.w3.org/hg/IndieUI/raw-file/default/src/indie-ui-context.html">https://dvcs.w3.org/hg/IndieUI/raw-file/default/src/indie-ui-context.html</a> and in the API and protocol to the cloud system).</td>
</tr>
</tbody>
</table>
Bibliography


