Objectives, methodologies and research issues of learning analytics

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EDITORIAL

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Definition and background of learning analytics

Learning analytics refers to the analysis and interpretation of data related to learners’ behaviors and interactions during the learning process, as well as learners’ profiles and the learning contexts they are situated in (Ferguson, 2012; Hwang, Hsu, Lai, & Hsueh, 2017; Siemens & Long, 2011).

Learning analytics plays an important role in providing helpful suggestions to policy-makers, instructors or learners by analyzing learning logs or educational data (Baker & Inventado, 2014; Hwang, Hung, Chen, & Liu, 2014). The objective of learning analytics is to provide helpful information to optimize or improve learning designs, learning outcomes and learning environments based on the analysis results (Greller & Drachsler, 2012).

In recent years, learning analytics has become an important issue in education, in particular, in the field of technology-enhanced learning. Many researchers have emphasized the need to record and analyze what happens during the learning process so that the factors affecting students’ learning performance can be identified (Chatti, Dyckhoff, Schroeder, & Thüs, 2012; Hwang & Chen, 2016). Accordingly, plans for improving learning designs and learning environments can be proposed.

The popularity of Massive Open Online Courses (MOOCs) aimed at providing unlimited opportunities of online course participation via open access on the web has further encouraged researchers to reconsider the role of learning analytics. In the meantime, several scholars have started to emphasize the issues related to privacy and security management for those open educational data (Pardo & Siemens, 2014; Slade & Prinsloo, 2013).

Publications in this special issue

In this special issue, nine quality papers have been accepted for publication. Several studies have attempted to improve students’ learning performance based on the results of the analysis of learning behaviors. For example, one of the studies reports the experience of analyzing low-achieving children’s mathematics learning behaviors in a synchronous peer-tutoring system with a help-seeking mechanism; another study aimed to investigate the impacts of a speech-to-text recognition application on students’ learning performance, perceptions and behaviors by analyzing their learning processes. In addition, two studies analyzed students’ higher order thinking behaviors; one focused on the learning analysis of K-12 students’ online problem solving, while the other reports the analysis of students’ learning behaviors in a flipped programming classroom with problem-solving strategies.

Several of the researchers are interested in analyzing students’ sequential learning patterns or online interactive patterns to identify the factors affecting their learning performance, and to provide supports accordingly. For example, one study investigated the significance of sequential patterns among students’ contribution types in their knowledge-building discourse; another study analyzed students’ behavioral patterns in an online formative peer-tutoring environment; while one study investigated students’ learning behavioral patterns to explain how students’ learning achievement could be significantly affected in a digital game-based learning approach with different feedback models.

From these papers, it can also be seen that the popularity of online courses has encouraged the use of learning analytics approaches. For example, one study aimed to analyze the online learning
behavioral patterns and temporal changes of college students in online open courses, while another tried to improve students’ engagement and learning outcomes in a MOOC-enabled collaborative programing course by analyzing their learning behaviors.

**Discussion**

To sum up, this special issue provides a good reference to help researchers and educators to perceive learning analytics. To further provide well-organized information of learning analytics, the editors of this special issue summarize the objectives, methodologies and potential research issues of learning analytics research as follows.

**Objectives of learning analytics**

- Identifying students’ learning status or problems for delivering adaptive learning by analyzing their learning behaviors or interactive content and providing personalized learning contents, user interfaces or practices.
- Enabling policy-makers and administrators to have a global view of current educational policies or problems by analyzing large-scale educational data to identify important indicators for evaluating the educational status from local, regional, national or international perspectives.
- Enabling researchers or teachers to have insights into students’ interactions with courseware, peers and teachers by analyzing their behaviors from in-depth aspects, such as raising a question with scientific conceptions, seeking information related to a specific issue, making observations and comparisons, proposing new ideas or submitting a correct answer.
- Providing evidence to explain students’ learning performance in educational settings by analyzing the learning behavioral patterns of different groups of students; for example, why does one group of students have better learning achievements?

**Methodologies for learning analytics**

Several frequently adopted methods for learning analytics are listed as follows (Chatti et al., 2012; Papamitsiou & Economides, 2014; Picciano, 2012; Xu, Krzyzak, & Oja, 1993):

- Decision tree: Modeling the relationships between data items by developing the classification model in the form of a tree structure. A decision tree can be used to make predictions for new cases based on the model derived from the existing cases. For example, it can be used to predict whether individual students will drop out of an online course based on a model built by analyzing the online learning behaviors of the students who dropped out and those who finished the online courses.
- Clustering: Grouping a set of data items such that the items in the same group (i.e. the same cluster) have more similar features than those in other groups. It can be used to identify students with similar features for recommending learning contents or goals to individual students.
- Association rules: Finding the occurrence relationships of learning contents/behaviors, the structure of learning contents or the layout of learner interfaces. It provides helpful information for researchers to determine learning paths or the structure of learning content by linking relevant learning materials. It could also provide references for recommending personalized learning content to those students whose behaviors or performances meet the premise of some association rules.
- Time sequence analysis: Finding the sequential relationships between learning behaviors or interactive content for determining the students’ learning behavioral or interactive models. It could be
useful to those researchers who intend to analyze students’ learning patterns so as to explain why some students have better learning performance. It could also be a reference for teachers to provide feedback to individual students.

- Visualization techniques: Presenting a data set in the form of graphs or images to help interpret the data from different and global perspectives. For example, it could be useful to policy-makers for examining the impacts of the past educational policies and making adjustments accordingly.

**Potential research issues**

- Proposing new approaches of learning analytics and educational data mining
- Investigating the impacts of providing personalized supports based on educational data mining on students’ learning performances
- Making predictions regarding students’ learning performances based on the analysis results of their learning behaviors
- Visualizations of learning activities with educational data
- Developing theories and models of learning analytics
- Analyzing students’ behavioral patterns to explain their performance in learning with different strategies, tools or technologies
- Comparing the behavioral patterns of the students with different personal factors, such as learning achievements, cognitive styles, learning styles or motives
- Analyzing students’ learning behaviors in different learning systems or environments
- Developing learning models or assessment models based on learning analytics results
- Proposing new learning analytics algorithms for learning environments or learning technologies
- Proposing effective data integration, cleansing methods and management tools for processing educational data
- Investigating privacy and security management for open educational data

**Conclusions**

The rapid advancements in sensing technologies (e.g. wearable devices and body signal-detecting devices) provide new opportunities as well as challenges to researchers in developing adaptive learning systems and investigating relevant issues. It can be predicted that, for educational technology research, reporting only learners’ achievements and perceptions based on their test results and feedback to self-reported questionnaires might not be good enough in the future. Researchers would like to know more about what happens to the learners during the learning process. It is expected that more evidence can be provided via analyzing the data collected in the learning process. In the meantime, to develop effective learning systems that can provide learning supports or suitable learning contents to individual students, it is important to analyze their learning behaviors in addition to their learning performances. Therefore, there is no doubt that learning analytics is one of the most important research trends in the field of educational technology. The aim of this special issue is to present the current status of learning analytics studies, which could be a good reference for those who intend to engage in this field in the future.

**References**


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