

eLAT: An Exploratory Learning Analytics Tool for Reflection and Iterative Improvement of Technology Enhanced Learning

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Educators are in need for powerful Learning Analytics tools in order to improve the effectiveness of their courses and to enhance their students' performance. In order to help educators to self-reflect on their technology-enhanced teaching and learning scenarios and to help them identify opportunities for interventions and improvements, it is important to provide comprehensible indicators for determining quality and efficiency. In this paper, we present an overview on the goals, requirements, and design of eLAT, a Learning Analytics toolkit which enables teachers to explore and correlate content usage, user properties, user behavior, as well as assessment results based on graphical indicators. The primary aim of eLAT is to process large data sets in real time with regard to individual research interests of teachers and data privacy issues.

Key Words and Phrases: Learning Analytics, Improving educational software, Evaluating teaching interventions, Improving teacher support

1. INTRODUCTION

The exploratory Learning Analytics Tool (eLAT) serves teachers to explore and correlate content usage, user properties, user behavior, as well as assessment results. Based on individually selected graphical indicators it supports reflection on and improvement of online teaching methods based on personal interests and observations. Therefore, eLAT has to provide a clear and usable interface while, at the same time, being powerful and flexible enough for individual information exploration purposes (Dyckhoff, 2011).

2. ELAT: EXPLORATORY LEARNING ANALYTICS TOOL

The requirements analysis of eLAT led to the following software design goals:

- *Usability*: provide an understandable user interface and appropriate methods for data visualization.
- *Interoperability*: ensure compatibility for any kind of LMS by allowing for integration of different data sources.
- *Extensibility*: allow the incremental extension of analytics functionality after the system has been deployed without rewriting code.
- *Reusability*: use a building-block approach to make sure that more complex functions can be implemented by re-using simpler ones.
- *Real-time operation*: make sure that the toolkit can return answers within seconds to allow an exploratory user experience.
- *Data Privacy*: preserve confidential user information and protect the identities of the users at all times.

eLAT is supposed to indicate certain facts about the usage and properties of a learning environment and visualize them appropriately. Therefore, we have introduced the concept of *indicators*, which can be described as specific calculators with corresponding visualizations. Indicators are arranged according to *analytics contexts* which correspond to the subject of a specific question a teacher might have.

One possible analytics context is “Content Activity”. It contains indicators, such as “Unique student activity for areas”, displaying an interactive visualization for content usage of different course areas during a particular period of time, while providing an overlay with the event of that course. Other analytics contexts are, e.g., „Assessment”, „Collaboration“, or „User Activity“. For every indicator any number of parameters may be added to narrow down a question according to certain date ranges, content areas or user properties. The set of available indicators for each analytics context is dynamically calculated dependent on the currently selected learning environment. This is necessary, as not all indicators can be applied to all kinds of course types in a meaningful way.

A typical use case of eLAT would consist of a teacher with a specific question in mind. With the selection of a context, a list of available indicators will be displayed. If required, the indicator will generate user interfaces to let the teacher supply parameters. After validating the configuration, a website will generate an indicator report along with some environment variables, store it in report tables, and send an evaluation request for that report to the evaluation service queue. After the evaluation has been completed, the user will be notified and the default visualizer for this indicator will retrieve the report and generate a result view.

A crucial part of eLAT’s system architecture handles the extensibility and reusability of the existing code base, so that the scope of operations can be increased with the need for new questions that naturally arise after one question has been answered. A single indicator implementation makes use of smaller parts in the form of *expressions* that are performance-optimized database queries to retrieve specific result sets, which can be useful for other indicators as well. The same practice is applied to the dynamic user interface generation for indicator parameters and the visualizers which operate on standardized datasets and are therefore generic to the data inside the report. This leads to a small effort for implementing new indicators. To keep the eLAT implementation independent of a particular LMS, we have developed a neutral data model which supports all major data types as well as an extension model to fit in special types.

During winter term 2010/2011, we selected four courses of RWTH Aachen University that differed in course size, learning technologies and teaching styles. We logged the students’ activities, interactions and assessment data for a period of three months. The collected data was pseudonymised to preserve the privacy of students. Due to this procedure, it was possible to get immediate feedback on early prototype stages.

3. CONCLUSION AND OUTLOOK

The main goal of eLAT is the improvement of teacher support with graphical analytics. Currently, eLAT has been primarily developed with the intention to support teachers in their ongoing reflection, evaluation and improvement activities. eLAT has been successfully tested with data collected from four courses. In the future, we plan to test eLAT with more courses from different disciplines and enhance eLAT in ways that students can use it as well. Future work will also include the evaluation of eLAT from a usability point of view and its enhancement with a recommendation component.

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