Workshop on Learning Analytics

Intertwining Adaptive Learning and Learning Analytics.

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Abstract: Learning Analytics collect and analyze a plethora of data on learners and their learning environments. A major aim is using these additional insights for offering adaptive learning to highly heterogenous learners. However, to date the adaptivity is still limited and mostly predefined as well as calling for further integration of technical and pedagogical perspectives. Therefore, this workshop focuses on how Learning Analytics approaches can enhance adaptivity as well as other current topics in the domain of Learning Analytics. Thus, this workshop called for submissions in the domain of Learning Analytics among others with emphasize on adaptive learning, adaptive assessments, models and algorithms for adaptation. Three submissions were accepted for presentation on a half-day workshop.

Keywords: learning analytics, adaptive learning

1 Introduction

The adaption of learning and instruction is a central goal of Learning Analytics [Ag18]. [Ch12] describes adaptivity as the ability to change learning contents based on a set of predefined rules and other parameters. The principle behind adaptive educational systems is that, depending on information about the student and the current situation, a suitable adaptation method should be chosen to adapt the presentation of learning material, instructions, and the user interface to the individual learner.

Adaptive learning can be considered as „a way of delivering learning materials online, in which the learner's interaction with previous content determines (at least in part) the nature of materials delivered subsequently. The process is automated, dynamic, and interactive. Its purpose is to generate a personalized learning experience." [Ke16, p. 88].

Although research on Adaptive Learning Environments dates back to the 1980s, there has been a significant growth in research in recent years [AHA17,KSJ17,Bi17,Xi19, No19,AAC20,Os20,Ma20,KPO21]. Drivers of this development are advances in artificial intelligence including educational data mining but also the dissemination of Learn-

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ing Analytics. Adaptive Learning Systems make use of data about students, learning process, and learning products to adapt the level or type of instruction or learning path for each student. Commonly, this adaptivity takes the form of selecting items from a large repository of learning items to match the current learning ability of a student. Application areas range from adaptive tests, learning paths, solution hints, and feedback to supporting self-regulated learning.

Martin et al. [Ma20] integrate prior theoretical assumptions and propose an adaptive learning framework that includes the learner model, the content model and instructional model. In their framework, the learner model includes affective, behavioral, and cognitive characteristics of the learner answering the question to what will be adapted. The content model includes the learning contents and interdependencies whereas the instructional model aims at adapting the instruction to learners under consideration of content and
learner model. Hence, these latter two models focus on what will be adapted (e.g., pace, sequencing, format of instruction) to the learner. To adapt the content and instructional model Martin et al. recommend an adaptive engine using artificial intelligence for selecting contents, learning objectives, timing, and presentation formats resulting in different paths and recommendations that meet learners' personal needs.

The relationship between Learning Analytics and adaptive learning becomes particularly clear in the example of learner models. For the construction of learner models, two traditional methodologies have been extensively researched: Knowledge Tracing and Factor Analysis. Knowledge Tracing approaches leverages the sequences of students' interactions with the system to model the evolution of their knowledge state over time and forecast their future replies. Leading models in this category are Bayesian Knowledge Tracing that use Hidden Markov Model or Recurrent Neural Networks. The second frequent strategy for learner modelling is Factor Analysis, which, other to Knowledge Tracing approaches, ignores the sequence of events in favor of learning a set of generalizable factors about data from a collection of observations. Which algorithms are appropriate for particular adaptive learning opportunities is an open question. The treatment of missing data as well es the automatic interpretation of captured data are still challenging for adaptive learning systems. While many of these approaches can be considered as technically proven, there is still a lack of generalizable, i.e. cohort and subject independent models that can stand up to the test in real learning setting. Learning Analytics play a central role for investigating adaptive treatments of this kind.

Apart from the use of adaptive systems for research purposes, there are a number of questions concerning their use in regular teaching: How can decisions of the adaptive system be made transparent and comprehensible to the learner? How do learners and the adaptive system interact with each other? What are the didactic premises of adaptive learning? How can teachers be involved in the adaptation process using Learning Analytics? What ethical guidelines do adaptive systems need? How can learning be adaptive without being unfair with regard to equal learning opportunities?

The Learning Analytics workshop aims to intertwine research on adaptive learning and Learning Analytics. We would like to share common perspectives, research questions, approaches and methods. In addition, the event will serve to identify important challenges in using Learning Analytics with regard to adaptivity.

2 Goals of the workshop

The overall goals of this interdisciplinary workshop are: (i) Networking of the LA community in the German speaking countries to initiate research and joint projects as well as fostering network activities beyond this workshop; (ii) Presentation of current research projects and results; (iii) Enhancing the interdisciplinarity in the working group: e.g., computer sciences, artificial intelligence, math, learning sciences and psychology as well as ethics and philosophy; (vi) Developing a joint outcome (e.g., paper, digital learning resources, event) based on the workshop discussions.

3 Submissions to the workshop

The call for papers for the workshop has been published online: https://learning-analytics.eu/call-for-papers-2022 and allowed submissions presenting work in progress and preliminary results to the community. Submissions have been peer-reviewed. In total, 6 submissions have been accepted for publication. The accepted papers deal with topics related to reading comprehension, indicators for supporting personalized and adaptive learning as well as production style features of educational videos.

4 Workshop summary

The workshop took place as a half-day event with up to 35 participants. In the beginning the organizers introduced the topic of the workshop followed by the paper presentations and their discussion.

In the first presentation Dennis Menze demonstrated an advanced tool to support reading activities of students reading longer texts. The precise measuring and visualizing of students' reading activities was extended by reading comprehension support. Measuring reading comprehension is based on students' answers to automatically displayed questions about the text sections they have just read. In this way, self-regulated learning can be promoted in relation to the domain-specific content and possibly also in relation to meta-cognitive learning and reading strategies. Future directions to improve adaptivity, interventions, automation, and measurement of reading comprehension have been discussed.

Yvonne Hemmler presented the second paper about an interview study investigating indicators for personalized and adaptive learning environments in online further educa-

tion. The identified indicators included variables about the internal learning context (e.g., demographics, skills, values, motivation) and external learning context (e.g., job characteristics, course characteristics). The authors hope that the indicators might help to make accurate predictions about learning processes and outcomes and to design adequate interventions to individually support learning.

In the third presentation Fatima Maya showed an approach to extract the production style of education videos with deep learning. This research will help answer the question of whether different visual characteristics of videos have an impact on learner engagement and knowledge gain. Production styles such as. female/male instructor, handwriting, whiteboard, pen, slide presentation, and animation is a remarkable visual property of educational videos. The authors introduced a use case for object detection models to recognize the human embodiment and the type of teaching media used in the video. The presented approach is intended to develop an automatic video assessment system.

At the end of the workshop, perspectives and next steps of the Arbeitskreis Learning Analytics (AKLA) were discussed. AKLA has set itself the goals of (i) developing an LA community in German-speaking countries, (ii) strengthening research, teaching and application, (iii) promoting interdisciplinary and cross-organizational cooperation and (iv) expanding international visibility. As the first steps towards achieving these goals, the new website (https://learning-analytics.eu/) and logo were presented. Currently, the website contains an archive of the past workshops including the publications since the year 2013. It is planned to maintain a regular exchange between the community members in the future (e.g., through monthly meetings, events as part of the Learning Analytics Learning Network).

5 Organizing team and program committee

The workshop was organized by Dr. Niels Seidel (FernUniversität Hagen) and
Dr. Clara Schumacher (Humboldt-Universität zu Berlin).
Members of the program committee have been:
Prof. Dr. Niels Pinkwart, Humboldt-Universität zu Berlin
Prof. Dr. Agathe Merceron, Beuth-Hochschule Berlin
Prof. Dr. Tanja Käser, École polytechnique fédérale de Lausanne (EPFL)
Prof. Dr. Katharina Simbeck, Hochschule für Technik und Wirtschaft Berlin
Prof. Dr. Dirk Ifenthaler, Universität Mannheim
Dr. Jakub Kuzilek, Humboldt-Universität zu Berlin
Dr. Slaviša Radović, FernUniversität in Hagen

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