8th International Workshop on Personalization Approaches in Learning Environments (PALE 2018) Preface

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ABSTRACT

Personalization is a well-established topic in education and there have been over 30 years of experience in adaptation and personalization approaches that use artificial intelligence. Bringing together methods, techniques and experiences from these research areas is the motivation of PALE this year at AIED. Its aim is to share and discuss the new trends in current research, with specific focus on how current research on artificial intelligence combined with data science and other disciplines can support designers and developers to improve learning in its different stages. The purpose is to give and share promising ideas on approaches that cater for the increasing amount of information available from immediate (e.g., in terms of wearable devices) to broader contexts in order to provide personalized learning assistance bridging the behavioral and the computational. In particular, this eighth edition of PALE workshop includes 6 papers dealing with detecting reading strategies, providing personalized scaffolding to support student learning of written argumentation, using digital avatars who resemble learners to investigate their impact on learning, evaluating the learning effectiveness of a recommender system, comparing the performance of a proposed eye-gaze feature classification method, and providing instructors with visualized information on sentiment and affective state of their students.

CCS CONCEPTS

•**Applied computing** → **Education** → *Interactive learning environments;* • **Information Systems** → **World Wide Web** → Personalization • **Users and interactive retrieval** → Personalization

KEYWORDS

Personalization, Adaptive Learning Environments, Engagement, Context Awareness

1 INTRODUCTION

The 8th edition of the International Workshop on Personalization Approaches in Learning Environments (PALE) took place on June 30th, 2018 and was held in conjunction with the 19th International Conference on Artificial Intelligence in Education (AIED 2018). This workshop is a follow-up of seven previous editions. The focus of this workshop series is put on the different and complementary perspectives in which personalization can be addressed in learning environments (e.g., informal, workplace, lifelong, mobile, contextualized, and self-regulated learning). Previous editions addressed several important topics in this field, such as behavior and embodiment of pedagogic agents, suitable support of self-regulated learning, appropriate balance between learner control and expert guidance, design of personal learning environments, contextual recommendations at various levels of the learning process, tracking of and reaction to affective states of learners, harmonization of educational and technological standards, big data processing for learning purposes, predicting student outcomes, adaptive learning assessment, and evaluation of personalized learning systems.

The first five editions of the PALE workshop led to the Special issue on User Modelling to Support Personalization in Enhanced Educational Settings in the International Journal of Artificial Intelligence in Education (IJAIED) [1].

From the past experience we have identified new areas of interest in this research scope to complement the previous ones. Thus, in this workshop edition we aim at sharing and discussing the new trends in current research on how user modeling and associated artificial intelligent techniques are able to contextualize and manage the increasing amount of information coming from the task at hand and its surrounding environment in order to provide the

personalization support in a wide range of learning environments, which are increasingly more sensitive to the learners and their context. This covers many interrelated fields such as: intelligent tutoring systems, learning management systems, personal learning environments, serious games, agent-based learning environments, and others. Furthermore, we aim to cover the demanding need of personalized learning in wider contexts ranging from daily life activities to massive open online courses (MOOCs). Thus, PALE offers an opportunity to present and discuss a wide spectrum of issues and solutions.

Following the experience from previous editions of this and related workshops, PALE combines the classic 'mini-conferences' approach with working group meetings around a specific problem. It follows the Learning Cafe methodology to promote discussions on some of the open issues coming from the presented papers. Each Learning Cafe consists of brief presentations of the key questions posed and small group discussions with participants randomly grouped at tables. Each table is moderated by one expert in the topic under discussion (mostly the presenter of the paper who has addressed the issue) and participants change tables during the discussion with the aim to share ideas among the groups.

What follows is an introduction of PALE 2018 motivation and themes as well as an overview of the contributions accepted and discussed in the workshop.

2 MOTIVATION

PALE 2018 is focused on enhancing sensitivity towards the management of big educational data coming from learners' interactions (e.g., multimodal sensor detection of attention and affect) and technological deployment (including web, mobiles, tablets, tabletops), and how can this wide range of situations and features impact on modeling the learner interaction and context. In the current state of the art it is not clear how the new information sources are to be managed and combined in order to enhance interaction in a way that positively impacts on the learning process whose nature is essentially adaptive. Thus, this edition of PALE at AIED 2018 aims to give and share promising ideas to the research question: *"Which approaches can be followed to cater for the increasing amount of information available from immediate (e.g., in terms of wearable devices) to broader contexts in order to provide effective and personalized assistance in learning situations bridging the behavioral and the computational?"* Thus, it captures current trends of the research fields of AIED, learning sciences, learning analytics as well as multimodal interaction research in HCI.

The AIED session of PALE includes (but is not limited to) the following topics:

- User engagement in learning processes
- Data processing within and across learning situations
- Ambient intelligence
- Learner and context awareness
- Cognitive and meta-cognitive scaffolding
- Cognitive and meta-cognitive scaffolding
- Adaptive mobile learning
- Wearable devices for sensing and acting in ubiquitous learning scenarios
- Tracking technologies for accessible learning for all

3 CONTRIBUTIONS

A peer-reviewed process was carried out to select the workshop papers. At least three members of the Program Committee with expertise in the area reviewed each paper. As a result, 6 submissions were accepted (out of 7), which discuss ideas and progress on several interesting topics, such as detecting reading strategies, providing personalized scaffolding to support student learning of written argumentation, using digital avatars who resemble learners to investigate their impact on learning, evaluating the learning effectiveness of a recommender system, comparing the performance of a proposed eye-gaze feature classification method, and providing instructors with visualized information on sentiment and affective state of their students. All these works specially focus on the enhanced sensitivity towards the management of educational data coming from multimodal learners' interactions and technological deployment, and how can this wide range of situations and features impact on modeling the learner interaction and context.

In particular, there are four contributions that deal with multimodal input data.

Kachergis et al. [2] describe a supervised machine learning based system aimed at detecting reading strategies in task-oriented readings. Three relevant reading strategies features were detected (the ratio of sentences that readers skimmed too quickly, the number of unique sentences read, and the variance of time spent reading each sentence). These features are easy to automatically extract in tablet based reading and differ from typical process variables used to study task oriented reading. The study involved 44 fourth-year vocational secondary training students and 1091 graphs of students' behavior recorded on tablets, which were classified by human coders. These ratings were used to train a classifier (eXtreme Gradient Boosting) on 13 features extracted from the students' reading behavior. The overall accuracy for classifying reading strategies was 0.74, significantly greater than chance. Searched reading strategies were the easiest to identify, with a balanced accuracy of 0.84, followed by intensive (0.81) and targeted reading strategies (0.69). However, both human coders and the classifier had difficulty identifying targeted reading, suggesting a need for further research.

Elouazizi et al. [3] report a pilot study on the use of the MindWare software, which offers personalized scaffolding to support student learning of written argumentation. This system is equipped with Natural Language Processing and Machine Learning modules that analyze and weigh the usage of the components of an argumentation voice, viz., the balanced use of stancing, hedging, logical connections, and coherence. MindWare is used to scaffold the metacognitive processes that underlie learning aspects of

written argumentation in the context of science education. To this it provides, in terms of dashboards, scaffolding and formative feedback (in visual and numerical form) to the learner and the performance of a particular student, and/or those of groups of students to the instructors. Preliminary results from a small-scale pilot show that meta-cognitive scaffolding strategies have contributed to increasing the levels of the learners' confidence in appreciating and using the components of the argumentation voice in their written essays. From the study follows that it is required further analysis on both (1) how the components of the argumentation voice have evolved or devolved across the drafts of the essays the students have submitted to MindWare, and (2) the significance, if any, of the changes in the grades of the students.

Parikh and Kalva [6] present a paper that focuses on comparing the performance of an eye-gaze feature classification method proposed by the authors (FWLC, a non-probabilistic statistical feature weighted linguistic classifier) with five popular classifiers. The ultimate purpose is to detect learning difficulty during a learning exercise and adapt content. More specifically, learning difficulty is defined here in terms of the novelty of words in written text. This is reflected in the classification process, which "classifies into two level of learning: a novel (positive class) or a familiar (negative class)". From a preliminary small-scale case study involving eight students, results show that the given method (in its three versions) provides better True Positive Rates (TPR) for novel words than the five machine learning classifiers. However, the mean prediction accuracy of the best classifier is 6,6% higher than the best version of FWLC. From this study, follows that both the method and its usage needs further research.

The work described in Schubert et al [7] provides instructors with visualized information on the sentiment and affective state of their students and allows them to examine how the students' sentiment and emotional state change over the duration of a course. The approach is aimed at showing to the instructor both the sentiment of the overall group of students and the emotional state and personality features of an individual student. The ultimate purpose here is to leverage the combination of these approaches in order to enable instructors to know how a very large body of students are perceiving the work to be performed as well as personalize intervention techniques based on the situation an individual is facing. However, the approach, which uses Microsoft Text Analytics API (for sentiment extraction) and IBM Watson Tone Analyzer (for detection of emotional state and personality profile) was not used for actual interventions yet. The paper concludes pointing to further research on scoring text based on several factors including the subject domain, weighting and managing posts and tracking interventions to trigger and refining appropriate actions.

The other two papers propose a technological deployment.

Wang et al. [4] discuss the design and evaluation of a digital doppelganger as a virtual human listener in a learning-by-explaining paradigm. Digital doppelgangers are virtual humans that highly resemble the real self but behave independently. The paper investigates how the increasing similarity of the physical appearance between the agent (built with Rapid Avatar Capture and Simulation: RACAS) and the student may impact on their learning. The analysis and results from a preliminary study involving 41 students focused on their perceptions while interacting with both a doppelganger avatar and a virtual human (with photorealistic appearance, not based on any resemblance to the participant), offer some clues into the possibilities and limitations of the application of this technology to build pedagogical agents. The paper did not find any significantly statistical result over different hypothesis but found some evidence on a possible trend that personalizing a pedagogical agent's appearance to be similar to the student's physical appearance may play a role in the efficacy of pedagogical agents. Still, this issue needs to be further investigated.

Dang and Ghergulescu [5] focus on evaluating the learning effectiveness of a recommender system (powered by Adaptemy's AI Engine) in terms of average lesson success rate and improvement per lesson. The data used in this analysis comes from 4257 students and 80266 learning lessons in a Math course. Three main cases with different levels of teachers' guidance are studied. In the first case the system makes recommendations with no input from the teacher, in the second recommendations are loosely-guided by teacher input through assignment in a topic, and in the third there are no system recommendations but lessons specified by teachers. The centre of the recommendation is the specific concept to work with. In each case the results are compared between the lessons done on system-recommended concepts and the lessons done on other concepts. The results indicated that both the learning success-rate and the improvement per lesson are higher if the system-based recommendations are followed, in all the three cases. According to this study, choosing the right difficulty levels of concepts to be worked on is part of the reason why working on the concepts recommended by the engine would gain higher improvement per lesson.

4 CONCLUSIONS

The current edition of the PALE workshop deals with several interesting issues: detecting reading strategies in task-oriented readings, personalized scaffolding to support student learning of written argumentation, investigating how the increasing similarity of the physical appearance between the agent (a digital doppelganger) and the student may impact on a learning-by-explaining paradigm, evaluating the learning effectiveness of a recommender system in terms of average lesson success rate and improvement per lesson, comparing the performance of a proposed eye-gaze feature classification method with five popular classifiers, and providing instructors with visualized information relating to the sentiment and affective state of their students and allow them to examine how the students' sentiment and emotional state changes over the duration of a course.

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