Personalization Approaches in Learning Environments

Olga C. Santos[1], Milos Kravcik[2], and Diana Pérez-Marín[3]

[1] aDeNu Research Group, Artificial Intelligence Department, Computer Science School, UNED, Calle Juan del Rosal, 16. Madrid 28040. Spain
[2] RWTH Aachen University, Informatik 5. Ahornstr, 55. D-52056 Aachen, Germany
[3] Laboratory of Information Technologies in Education (LITE), Universidad Rey Juan Carlos
Calle Tulipán s/n. Móstoles 28933, Spain
ocsantos@dia.uned.es, kravcik@dbis.rwth-aachen.de, diana.perez@urjc.es

Abstract. Personalization approaches in learning environments can be addressed from different and complementary perspectives. PALE workshop aimed at the following issues: pedagogic conversational agents, responsive open learning environments, and user modeling for all. Hereby, we report the state of the art in this area as gathered in the workshop papers and comment on the future research directions as discussed during the sessions.

Keywords: Personalization, Learning Environments, Pedagogic Conversational Agents, Responsive Open Learning Environments, Inclusiveness, Accessibility.

1 Introduction

The International Workshop on Personalization Approaches in Learning Environments (PALE) took place on 15th of July 2011, in Girona (Spain) in conjunction with the International Conference on User Modeling, Adaptation and Personalization (UMAP). PALE [1] is the result of merging the experience and background of three more specific workshops:

- *Adaptation and Personalization in E-B/Learning using Pedagogic Conversational Agents (APLEC):* focusing on interactive learning environments that build the knowledge with the student through a set of interactions, such as in natural language by using animated Pedagogic Conversational Agents.
- *Personalizing Responsive Open Learning Environments (ROLE):* dealing with responsive open learning environments that permit personalization of the entire learning environment and its functionalities, i.e. individualization of its components and their adjustment or replacement by alternative solutions.
- *Towards User Modeling and Adaptive Systems for All (TUMAS-A):* addressing inclusive learning environments to provide a personalized, accessible and ubiquitous support for users using the appropriate technologies and standards as well as evaluation procedures.

L. Ardissono and T. Kuflik (Eds.): UMAP 2011 Workshops, LNCS 7138, pp. 117–121, 2012.
© Springer-Verlag Berlin Heidelberg 2012

The overall topics of interest of PALE included the motivation and benefits of personalization in learning environments, as well the techniques and methods used for personalization in three particular types of environments, namely interactive learning environments, responsive learning environments and inclusive learning environments. On top of these topics, a high-level research question was asked to the participants: "Which approaches can be followed to personalize learning environments?" It was crumbled in low level questions in each of the specific workshops.

We used the *learning café* methodology [2] to promote discussions in groups. It means participants sit around tables in groups of 6-8 people. Each table is presided by a moderator and has a special theme connected to those of the other tables by the overall topic of the discussion (see the PALE website [1] for the questions addressed and pictures from the workshop). Paper table clothes and pens are used by the participants to make their notes. After a discussion (e.g. 20 minutes) the group dissolves and the people change to other tables, except the moderators. At the new table the participants start to discuss again based on the notes on the table made by previous group(s). They have a new conversation with new people and make their notes too.

In the following we summarize the papers and compile future research directions as discussed during the workshop.

2 State of the Art

Benefits of personalization and adaptation of computer applications to the user have been reported in recent decades. A typical area is education, considering both e-learning (the use of electronic media to teach or assess) and b-learning (blended learning – a combination of traditional face-to-face instruction with electronic media). In this field, 12 submissions were accepted for the PALE workshop and included in the CEUR workshop proceedings [3], providing an overview of the current issues.

In the APLEC session, Cohen described how can learning factors be modeled as statistical processes in terms of probabilistic machines that move from state to state [4]. Kaochar presented her research on developing methods for non-expert humans to teach complex behaviors to autonomous agents by modeling human teaching patterns [5]. Redondo and Pérez-Marín proposed a procedure to generate questions adapted to the personality and learning style of the students to be included in Pedagogic Conversational Agents [6]. Leite et al. presented a case study with an empathic chess companion for children, based on a model of the user's affect [7].

The ROLE part started with Thai-Nghe et al., who proposed context-aware models both to recommend tasks to students and to predict their performance [8]. Johnson et al. discussed the need to extend open learner models with epistemic beliefs to support development of 21st century skills [9]. Muir at al. described an educational game with a hint-based pedagogical agent and how eye tracking can help to understand how students pay attention to the hints]10]. Minguillón et al. proposed a social layer on top of learning object repositories to annotate learning objects from a teaching perspective in order to improve searching and browsing [11]. Berthold et al. identified principles for a mash-up design in personalized learning environments and the importance of assigning widgets to psycho-pedagogical information in order to

provide learners with meaningful recommendations and guide them in the self-regulated learning process [12].

For TUMAS-A, Roldán et al. presented a proposal to adapt learning activities while students use multitouch tabletops that model structural aspects, contents and interactions [13]. Frias-Martinez and Virseda proposed a set of design suggestions to personalize and adapt mobile learning tools to enhance their educational impact in low-income communities by modeling the users' abilities and preferences [14]. Santos et al. discussed some of the existing open issues in personalized inclusive learning scenarios that deal with the analysis of existing standards, the building of user models, the definition of educational services, and the application of semantic educational recommender systems [15].

3 Future Research Directions

The discussions carried out in the Learning Cafés for the different workshop sessions suggested relevant research directions for the future. In the APLEC session participants identified different types of agents and questioned which was the best approach to present an agent to the user – just the face, the full body (either human-like or animal-like), or as a robot. From their perspectives, there are still many research issues regarding the embodiment. Agents should get the attention of the students but without distracting them with their features. Moreover, a human-like representation may not be the most appropriate as the users' expectations of its behavior may get very high, and a schematic approach would be more appropriate. In order to answer this question, user centered design methods are needed to get feedback from users. Another raised issue was what information is needed to model the agent behavior for personalization purposes and where to keep it, including the affective information that is needed to produce emphatic behaviors of agents.

ROLE discussions focused on the usefulness of Personalized Learning Environments (PLE) in order to support self-regulated learning. In the PLE approach, learners are involved in building their learning environments from small modules called widgets. A big challenge is to find an appropriate threshold between the learner control and tutor guidance. Personalized support can be provided by means of design templates and recommendations. In any case, this support has to be effective but not intrusive, considering the learner preferences. Moreover, these preferences are not static, but can change dynamically according to the context. One of the raised research issues was how to track affective states, since current wearable sensors and haptic devices are still quite intrusive. Participants suggested focusing the research on two scenarios where learners are supposed to have certain capabilities to guide themselves: higher education and lifelong learning. It was also suggested to consider meta-cognitive competences as well as results of behavioral and cognitive psychology when designing learning environments.

In the TUMAS-A learning café, the discussion started with the identification of Personalized Inclusive Learning (PIL) scenarios. As not all needs are covered by the typical scenario of learners studying the course contents, other ones have to be studied as well, like learners' enrolment or examination. In addition to the user impairments, accessibility preferences can include also technology availability or economic level. Standards and specifications seem appropriate to model the learners' preferences and

the course characteristics, but their harmonization is needed. The learning objects accessibility level is also critical to provide effective PIL. Existing repositories usually do not include accessibility annotations of their resources due to the additional effort required. Automatic approaches can help to simplify this process, for instance, by learning the accessibility metadata from the observed interactions (e.g. which devices are able to show which contents). They should also include automatic transformations to different output modalities, such as text to voice, and vice versa, while extending the quality reviewing workflow to allow accessibility experts to validate those issues that cannot be managed automatically. Finally, in the evaluation process several factors are to be considered. Evaluating personalization and accessibility independently is still a hot research issue; trying to evaluate both together seems even more challenging. More experiences are required to learn appropriate evaluation approaches. These experiences should differentiate the learning process itself from the learning outcomes produced, and consider both the peculiarities of the learning and teaching processes separately.

We expect that the outcomes from the PALE workshop can be helpful to motivate other researchers to work on them in order to improve user modeling, adaptation and personalization in learning environments.

Acknowledgments. The authors would like to thank their colleagues Jesus G. Boticario, Susan Bull, Effie Law, Noboru Matsuda, and Alexander Nussbaumer for their cooperation during the PALE workshop organization. Moreover, they thank the 32 members of the program committees involved in PALE[1] as well as the authors for their paper submissions and the 24 workshop participants for their active involvement. The ROLE specific workshop is supported by the ROLE Integrated Project (grant agreement no 231396) of the European Union. The TUMAS-A specific workshop is supported by A2UN@ (TIN2008-06862-C04-01/TSI), EU4ALL (IST-2006-034478), CISVI (TSI-020301-2008-21) and ALTER-NATIVA (DCI-ALA/2010/88) projects.

References

1. PALE workshop website: `http://adenu.ia.uned.es/workshops/pale2011/`
2. World Café Method: `http://www.theworldcafe.com/method.html`
3. Perez-Marin, D., Kravcik, M., Santos, O.C. (eds.): Proceedings of the International Workshop on Personalization Approaches in Learning Environments, held in conjunction with the 19th User Modeling, Adaptation and Personalization Conference (UMAP 2011), Girona, Spain. CEUR Workshop Proceedings (July 15, 2011) ISSN 1613-0073, `http://CEUR-WS.org/Vol-732/`
4. Cohen, P.: Processes in Learning. In: Perez-Marin, D., Kravcik, M., Santos, O.C. (eds.) Proceedings of the International Workshop on Personalization Approaches in Learning Environments, vol. 732, p. 2 (2011)
5. Kaochar, T.: Understanding How Humans Teach Robots. In: Perez-Marin, D., Kravcik, M., Santos, O.C. (eds.) Proceedings of the International Workshop on Personalization Approaches in Learning Environments, vol. 732, p. 3 (2011)

[1] The full list of program committee members is available at http://adenu.ia.uned.es/workshops/pale2011/committee.htm

6. Redondo-Hernandez, A., Perez-Marin, D.: Automatic Generation of Questions Adapted to the Personality and Learning Style of the Students. In: Perez-Marin, D., Kravcik, M., Santos, O.C. (eds.) Proceedings of the International Workshop on Personalization Approaches in Learning Environments, vol. 732, pp. 4–7 (2011)
7. Leite, I., Pereira, A., Castellano, G., Mascarenhas, S., Martinho, C., Paiva, A.: Social Robots in Learning Environments: a Case Study of an Empathic Chess Companion. In: Perez-Marin, D., Kravcik, M., Santos, O.C. (eds.) Proceedings of the International Workshop on Personalization Approaches in Learning Environments, vol. 732, pp. 8–12 (2011)
8. Thai-Nghe, N., Horvath, T., Schmidt-Thieme, L.: Context-Aware Factorization for Personalized Student's Task Recommendation. In: Perez-Marin, D., Kravcik, M., Santos, O.C. (eds.) Proceedings of the International Workshop on Personalization Approaches in Learning Environments, vol. 732, pp. 13–18 (2011)
9. Johnson, M.D., Reimann, P., Bull, S., Fujita, N.: Epistemic Beliefs and Open Learner Models. In: Perez-Marin, D., Kravcik, M., Santos, O.C. (eds.) Proceedings of the International Workshop on Personalization Approaches in Learning Environments, vol. 732, pp. 19–24 (2011)
10. Muir, M., Davoodi, A., Conati, C.: Understanding Student Attention to Adaptive Hints with Eye-Tracking. In: Perez-Marin, D., Kravcik, M., Santos, O.C. (eds.) Proceedings of the International Workshop on Personalization Approaches in Learning Environments, vol. 732, pp. 25–29 (2011)
11. Minguillon, J., Rodriguez, M.E., Conesa, J.: Improving Searching and Browsing Capabilities of Learning Object Repositories. In: Perez-Marin, D., Kravcik, M., Santos, O.C. (eds.) Proceedings of the International Workshop on Personalization Approaches in Learning Environments, vol. 732, pp. 30–35 (2011)
12. Berthold, M., Pachtchenko, S., Kiefel, A., Nussbaumer, A., Albert, D.: Identifying Requirements for a Psycho-Pedagogical Mash-up Design for Personalising the Learning Environment. In: Perez-Marin, D., Kravcik, M., Santos, O.C. (eds.) Proceedings of the International Workshop on Personalization Approaches in Learning Environments, vol. 732, pp. 36–40 (2011)
13. Roldan, D., Martin, E., Haya, P.A., Garcia-Herranz, M.: Adaptive Activities for Inclusive Learning using Multitouch Tabletops: An approach. In: Perez-Marin, D., Kravcik, M., Santos, O.C. (eds.) Proceedings of the International Workshop on Personalization Approaches in Learning Environments, vol. 732, pp. 42–47 (2011)
14. Frias-Martinez, V., Virseda, J.: Personalization Of Mobile Learning Tools For Low-Income Populations. In: Perez-Marin, D., Kravcik, M., Santos, O.C. (eds.) Proceedings of the International Workshop on Personalization Approaches in Learning Environments, vol. 732, pp. 48–53 (2011)
15. Santos, O.C., Baldiris, S., Boticario, J.G., Gutierrez y Restrepo, E., Fabregat, R.: Open Issues in Personalized Inclusive Learning Scenarios. In: Perez-Marin, D., Kravcik, M., Santos, O.C. (eds.) Proceedings of the International Workshop on Personalization Approaches in Learning Environments, vol. 732, pp. 54–58 (2011)