Chapter 2
Personalization and Adaptation in E-Learning Systems

Abstract Personalization is a feature that occurs separately within each system that supports some kind of users' interactions with the system. Generally speaking term "Personalization" means the process of deciding what the highest value of an individual is if (s)he has a set of possible choices. These choices can range from a customized home page "look and feel" to product recommendations or from banner advertisements to news content. In this monograph we are interested in personalization in educational settings. The topic of personalization is strictly related to the shift from a teacher-centred perspective of teaching to a learner-centred, competency-oriented one. Two main approaches to the personalization can be distinguished: user-profile based personalization and rules-based personalization. In the first case this is the process of making decisions based upon stored user profile information or predefined group membership. In the second case this is the process of making decisions based on pre-defined business rules as they apply to a segmentation of users. This chapter presents the most popular adaptation forms of educational materials to learners.

Today, personalization is feature that occurs separately within each system that supports some kind of users' interactions between user and the system. Generally speaking term "Personalization" means the process of deciding what the highest value of an individual is if (s)he has a set of possible choices. These choices can range from a customized home page "look and feel" to product recommendations or from banner advertisements to news content.

The concept of "Personalization" can easily be understood taking a closer look at some of the widely existing and using digital technologies that offer personalization and customization options: browser that help to roam the Internet, email and messaging systems, the digital boxes that help to watch TV online.

Two main approaches to the personalization can be distinguished: user-profile based personalization and rules-based personalization. In first case this is the process of making decisions based upon stored user profile information or predefined group membership. In the second case this is the process of making decisions based on pre-defined business rules as they apply to a segmentation of users.

2.1   Personalization and Personalized Learning

In this monograph we are interested in personalization in educational settings. In e-learning area, "personalization" has a wide range of new meanings. One of the best explanations could be that "Personalized learning is the tailoring of pedagogy, curriculum and learning environments to meet the needs and learning styles of individual learners" (Baguley et al. 2014).

The topic of personalization is strictly related to the shift from a teacher-centered perspective of teaching to a learner-centered, competency-oriented one. In contrary to conventional e-learning which tends to treat learners as a homogeneous entity, personalized e-learning recognizes learners as a heterogeneous mix of individuals.

Essentially personalized e-learning offers to learner's customization of a variety of the elements of the online education process:

- The learning environment—content and its appearance to the learner (like backgrounds, themes, font sizes, colours, and so on)
- The learning content itself—multimedia representations (like textual, graphical, audio, video, and so on)
- The interaction—include facilitator, student and the learning content (e.g. mouse, keyboard, tap/swipe; e.g. using Quizzes, Online discussions, "Gaming", Tutorials, Adaptive learning approaches)

Apart from the above mentioned ways of personalization (like the "preferences" and "settings" options that most digital tools offer) other aspects of the learning environment and process can be personalized:

- What content should be delivered during the learning process?
- How the content should be delivered with special attention to the sequence of its delivery.
- How students will be evaluated and also with special attention what feedback options will be used.

Nowadays it is unavoidable demand that educators have to re-evaluate e-learning courses and there are a lot of important factors that determine it, like: age, cultural background, the level of education, demographics and so on. Numerous important aspects should be taken into account when deciding to personalize an e-learning environment:

- **Personalize the environment**—determine how online e-learning environments should look like.
- **Personalize the content**—incorporate content from the learners' personal environment (reflect learners' browsing habits and preferences).
- **Personalize the media**—according to their learning styles and preferences some learners like to watch a short video or read a printed PDF files.
- **Personalizing learning sequences**—nonlinear presentation of contents allows learners to choose how they will learn.

- **Personalize the roles using photographs and pictures**—use a photograph of the instructor to make the content more "personal."
- **Personalize the conversation**—use text or voice/video and adjust used sentences.
- **Personalize the navigation**—allow learners to explore various parts of the content.
- **Personalize the learner**—Make the course personal to the learner.
- **Recognize individual competency**—skip known parts of teaching material and start learning the new topics.
- **Personalizing learning objectives**—Enable learners to achieve better the learning objectives.

Harmonization of mentioned aspects will obtain a truly Personal Learning Environment (PLE) and give learners the chance to learn what they want when they want, and even to learn according to the preferred method of learning!

2.2   Adaptation of E-Learning Systems

In the last few decades "Adaptation in E-learning" has generated tremendous interest among researchers in computer-based education. As a consequence, two key terms appeared: adaptivity and adaptability. Adaptivity is such kind of behaviour where the user triggers some actions in the system that guides the learning process, i.e. modifies e-learning lessons using different parameters and a set of pre-defined rules. Adaptability is such kind of behaviour where the user makes changes and takes decisions on the learning process, i.e. it is a possibility for learners to personalize an e-learning lesson by themselves (Khemaja and Taamaallah 2016).

These terms caused a series of possibilities, from those centered on the machine (adaptivity) to those centered on the user (adaptability). Adaptation in e-learning today incorporates new technologies and ways of expression practically moving ahead from Computer Based Training and Adaptive Hypermedia Systems.

Adaptation is usually focused on the student. Also, it is possible adaptation that involves instructors, but it requires deeper instructor's involvement and it could be more time and resource consuming. In such educational settings instead of giving collective lectures the instructor should provide a personal or group guidance.

Adaptivity and adaptability are inseparable from personalized learning. Adaptation in e-learning could be seen as a method to create a learning experience for the learner but also for the instructor. In order to increase the performance of pre-defined criteria (like economic, educational, user satisfaction-based or time-based) instructor must configure a set of specific elements (usually based on content, interface, order, time, assessment, and so on).

Three essential inputs exist in a balanced formula for adaptation: the user (learner, student), the teacher (tutor, instructor), and the set of pre-defined rules made by the learning instructor i.e. designer.

Usually, three essential types of adaptation have been proposed in literature:

1. **Interface-based (also known as adaptive navigation)**. It relates to elements and options of the interface and usability and adaptability: where particular elements are positioned on the screen, which properties are defined (size, colour, etc.) and so on.
2. **Learning flow-based**. The learning process is dynamically adapted to the sequence in appropriate (different) ways the contents of the course is delivered.
3. **Content-based**. In such systems resources and activities dynamically change their actual content (for example systems based on adaptive presentation).

Also, there are some key researchers in e-learning area (Brusilovsky 2004) who recognized and proposed several additional kinds of adaptation:

1. **Interactive problem solving support**. In order to get an appropriate solution to a problem the learner is guided (from an online or offline tutor or from a predefined set of rules) to the next step in the learning process.
2. **Adaptive information filtering**. In order to provide relevant and categorized outputs to the learner system takes care of appropriate information retrieval.
3. **Adaptive user grouping**. Such kind of systems allows ad hoc creation of learners' groups and collaborative support for performing particular tasks.

In (Burgos 2011) authors proposed further extension of the classification:

1. **Adaptive evaluation**. Based on the performance of the learner and the guidance of the tutor, elements like the actual content, the evaluation model, and the running of a test can be changed.
2. **Changes on-the-fly**. In these systems there is the possibility to adapt/modify a course on-the-fly by the instructor in run-time.

Adaptation and personalization are posing new research and development challenges to modern e-learning systems. E-learning definitely becomes smarter from the exploration of the efficiency of interaction analysis methods that empower these systems with adaptation and personalization. Recently advanced Artificial Intelligence techniques have been exploited for implementation of smarter online (but also blended learning) scenarios, including complex character of collaboration.

Analysis of trends in modern e-learning systems showed that the most popular types of personalization in today's e-learning systems are (Klašnja-Milićević et al. 2011):

- *Learning style identification*. Personalization of the system is based on the identified learning styles of each user of the system.
- *Recommendation systems*. These systems are used to recommend appropriate educational material to the learner and to select optimal paths through the learning materials.
- *Link adaptation*. The system modifies the appearance and/or availability of every link that appears on a course Web page, in order to show the learner, whether the link leads to interesting new information, to new information the

learner is not ready for, or to a page that provides no new knowledge. The system makes some links inaccessible to the learner if the system estimates from the learner model that such links take him/her for the irrelevant information.

- ***Personalised pedagogical agents***. The demand of modern e-learning systems is to make learning process more challenging, exciting and highly interactive. Usually e-learning environments are equipped with different kinds of agents that support more intelligent and human-like (teacher-to-student) communication within the system. Personal, pedagogical avatars (Haake and Gulz 2008) are a way to facilitate higher quality of delivering topics and assessing acquired knowledge.

References

Baguley, M., Danaher, P. A., Davies, A., De George-Walker, L., Matthews, K. J., Midgley, W., et al. (2014). *Educational learning and development: building and enhancing capacity*. Palgrave Macmillan.

Brusilovsky, P. (2004). KnowledgeTree: a distributed architecture for adaptive e-learning. In *WWW Alt. '04: Proceedings of the 13th international World Wide Web conference on Alternate track papers & posters* (pp. 104–113). http://doi.org/10.1145/1013367.1013386

Burgos, J. L. M. (2011). Semantic web standards. *SNET Computer Engineering*. Retrieved from http://www.pdffiller.com/948565-semantic-web-standards_burgos-Semantic-Web-Standards—SNET-Various-Fillable-Forms-snet-tu-berlin

Haake, M., & Gulz, A. (2008). Visual stereotypes and virtual pedagogical agents. *Educational Technology and Society, 11*(4), 1–15.

Khemaja, M., & Taamaallah, A. (2016). Towards situation driven mobile tutoring system for learning languages and communication skills: Application to users with specific needs. *Journal of Educational Technology & Society, 19*(1).

Klašnja-Milićević, A., Vesin, B., Ivanović, M., & Budimac, Z. (2011). E-Learning personalization based on hybrid recommendation strategy and learning style identification. *Computers & Education, 56*(3), 885–899.

E-Learning Systems
Intelligent Techniques for Personalization
Klašnja-Milićević, A.; Vesin, B.; Ivanović, M.; Budimac, Z.;
Jain, L.C.
2017, XXIII, 294 p. 126 illus., 102 illus. in color.,
Hardcover