

CONTEMPORARY APPROACHES TOWARD PERSONALIZATION IN E-LEARNING – MIAPP PROJECT

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ABSTRACT

In recent years a gradually more significant awareness of the potential benefits of adaptivity in e-learning has been witnessed. This has been mainly driven by the understanding that the perfect model of individualized learning - learning tailored to the specific requirements and preferences of the learner, cannot be achieved, at a massive scale, using traditional instructive approaches. The main goal of this report is to present the contemporary approaches to the personalization applied to e-learning, pointing the advantages and disadvantages of the personalization, its goals and forms combined with the recommendations of the future work in the context of lasting challenges of e-learning personalization. The report discusses briefly the multiple intelligence approach investigated in the MIapp research project.

KEYWORDS

E-learning, personalization, multiple intelligences,

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INTRODUCTION

E-learning has changed the way people learn dramatically (this concerns both vocational and educational training), however it seems that content developers and software vendors continue to ignore arising problems – a considerable higher drop-out rate, lower effectiveness and satisfaction in case of e-learning programs compared to traditional ones. According to the needs analysis¹, these problems result from lack of user centric, personalized approach.

Improvement of this situation can be made through a shift from technology to learner oriented solutions and the focus on human potential and abilities. This shift requires psychological approach, where Multiple Intelligences theory (MI) developed by prof. Howard Gardner (Harvard University) can be a good start point, since this theory has been used successfully in traditional education. This theory suggests that the traditional notion of intelligence, based on I.Q. testing, is far too limited. Instead, Dr. Gardner proposed eight different intelligences to account for a broader range of human potential. MI theory will be supplemented with other approaches that consider the influence of age, gender, culture education background, IT literacy, etc. on preferred training methods and career opportunities.

BACKGROUND

The first attempts to respond to the different needs and characteristics of a rapidly growing number of Internet users took place in the early 1990s. Personalized or the so called adaptive web systems, have since been utilized in various fields such as commerce, education, finance, and tourism. What distinguishes these systems from the traditional static solutions is the creation of a conceptual user model that represents the characteristics of the user, exploiting them in the creation of content and presentations adapted to different individuals.

¹ MIapp proposal, 2004.

Personalization becomes a useful tool in the selection and filtering of information for the user, facilitating navigation and increasing the speed of access as well as the likelihood that the user's search is successful.

Personalization should thus be understood as the use of technology and user information to tailor interactions between an organization or organization's web solution and each individual user. Using information either previously obtained or provided in real-time about the user, the exchange between the parties is altered to fit that user's stated needs as well as needs perceived by the parties based on the available information.

As the personalization most often occurs among commercial solutions, the purpose of this information technology combined with marketing practices specialized for the WWW is to:

- Better serve the customer by anticipating needs;
- Make the interaction efficient and satisfying for both parties;
- Build a relationship that encourages the customer to return for subsequent purchases.

The techniques available to collect information about users, as well as the methods used to process such information to create user profiles and to provide adapted information, are varied. A brief description of the different approaches constitutes the state of the art of the personalization technology used today, applied both to the commercial solutions as well as to the e-learning environments.

PERSONALIZATION TECHNIQUES

A basic important distinction relating to the amount of control that the user has on the adaptation process should be made by explaining differences between customization and personalization.

Customization, also called adaptability occurs when the user configures an interface or the whole communication process in order to create an own profile manually, adding, removing and editing the elements in the profile. The control of the look and content of the site or of the communication process are explicit and user-driven which means that the user is involved actively in the process and has direct control over the content he or she gets or over the environment used to deliver the content.

In personalization, sometimes called an adaptivity, on the other hand, the user is seen as being more passive, or at least somewhat less in direct control. Modifications concerning the content or the structure of a website (content delivery environment) are performed automatically by the system based on information concerning the particular user stored in the so-called user profile. Such information about the user is provided either directly, by the users themselves, where the tools such as online registration forms, questionnaires and reviewing (static profiles) can be used, or implicitly by recording the navigational behavior and preferences of each user through dynamic profiling web technologies such as cookies and web server log files.

Another perspective that defines the differences between personalization and customization is also common. According to this viewpoint personalization is adapting or sequencing solutions to fit individual differences, expectations, and needs. In contrast, mass customization is adapting to fit common characteristics identified for groups of learners. Mass customization is actually the first step in building an individual learning relationship. It may not always be practical to support one learner at a time or to build in total personalization capabilities specific to one learner. It may be preferable to start with a mass customized solution that identifies a few common critical success attributes that are key for improved performance. Good objectives, analysis, and personalization framework guide these choices.

After the data concerning the users behavior and expectations is collected, appropriate information is determined and delivered based on which the users' needs are defined. The whole process usually utilizes one or more of the techniques such as content-based filtering, collaborative filtering, rule-based filtering or web usage mining.

Content-based systems track and store user's navigation actions, behavior and preferences and as the consequence using historical data they recommend items that are similar to those that users liked in the past.

Collaborative filtering systems compare user's behavior with those of others in order to develop an image of people with similar needs. The choice of individualized content is then based on the assumption that this particular user will prize information that like-minded people also enjoyed. The user's expectations are either inferred from their previous actions but also commonly they are measured directly by asking the user to rate products, interaction process, customer service, etc.

Rule-based filtering systems, allow website administrators to specify various rules, based on static or dynamic users' profiles, that are then used to affect the information, content or the environment served to a particular user.

Web usage mining, which is based on the application of statistical and data-mining methods utilizes the web server log data, resulting in a set of patterns that indicate users' navigational behaviors. The patterns discovered are then used to provide personalized content to users based on their previous navigational activity.

Contemporary personalization and customization practices point to the three different levels where previously mentioned tools for personalization or customization can be applied. The three levels are: content, navigation and presentation. The selection and preparation of the adaptive content is based mostly on the information retrieval techniques. In practice, the system should respond to the user searches for relevant information by adaptively selecting and prioritizing the most relevant items. As the consequence, users can obtain results that are more suitable for their knowledge capabilities and cognitive skills. The second level - adaptive navigation support is delivered mainly on browsing-based access to information. The idea behind this is to manipulate the links to guide the user adaptively to most relevant information items as he or she navigates from one item to the other. At this particular level, personalization has the advantage of improving the usability of a website or learning environment by facilitating its navigation and aiding users in finding the desired information. With some knowledge about the user, the system can give specific guidance in its navigation, limiting the visitation space appropriately. The system can supply, or even just suggest, the most important links or content that could be relevant for the user. Finally, the level most relevant to the personalization and customization in e-learning - adaptive presentation which is based on adaptive explanation and adaptive presence. Both are developed by the self-governing and intelligent systems satisfying user's needs when he or she gets to a particular page by present its content adaptively. Content and presentation adaptability are crucial issues of the personalization and customization applied to e-learning as the possibilities of content and presentation adaptability are a relevant element in the reuse of the same resources for different purpose, provided they have been correctly customized in advance. Considering the high cost of personalization, adaptability of resources can also offer an interesting byproduct in term of reuse of the same resources in different contexts, provided that their description is correctly defined through standard metadata applications to allow interoperability of the same service in different environments. This observations are the basis of the contemporary applications of personalization and customization in e-learning.

WHY USE PERSONALIZATION IN LEARNING?

Successful teachers and trainers know that they can make a difference in the classroom with personalized approach, particularly in recognizing how individuals may need to learn differently. As good instructors, they intuitively deal with key motivation factors (e.g., passion, happiness, dislike, fear, will, frustration, satisfaction, and anger) to promote learning. These factors may be easily overlooked while teaching online. By considering the impact of emotions and intentions, educators can better understand how and why individuals learn differently. For example, some learners value learning in collaborative, environments. Other learners succeed in competitive learning. Some learners are passionate about exploring new challenges and taking risks. Finally, some learners are formally resistant to any kind of learning that appears to have little value or benefit to them. Few "one-size-fits-all" online learning models and solutions consider these important distinctions between learning types and, when necessary, try to manage these differences. Translating this kind of psychological information into learning strategies with the use of personalization helps designers create learning situations that work best for the intended audience.

Providing targeted information to users with different profiles and interests, personalized systems are much more likely to satisfy the user, who, as a consequence, is stimulated to come back and reuse the system or to encourage others to try it as well. This is why personalization is also a fundamental marketing tool for the development of visitor loyalty, as well as new audiences. Personalization has much potential when it comes to stimulating learning. Personalization techniques described earlier are an important form of support in education. The reasons for this are wide-ranging. Recognizing critical success attributes common to the learning group is vital in helping learners improve learning ability, understand how they learn best, and make educated choices about managing their learning environments. Learning is encouraged when the information provided is described in terms that the learner can understand. Using different terms and concepts, that takes into consideration the level of knowledge, age, education of the user, etc., can therefore improve the overall didactic experience leading to improved knowledge and skills adoption as a consequence. This is precisely what happens with personalized applications where the information delivered to the learners often changes according to whether they are a child, an adult, a novice or a professional.

Various studies indicate that learning is facilitated when the information and knowledge provided make reference to the knowledge that the users previously acquired. Concepts already encountered during navigation or exploration or the whole learning path make it much easier to memorize the new information or associate the information with its application which is transforming information into knowledge. This suggests that teachers should focus on activating learners' prior knowledge if possible. One of the means at their disposal is personalization, which could open new and effective means for long-term learning by providing adaptive descriptions of concepts being taught based on concepts that the learners find familiar.

The so called consequent experience is another mechanism that can justify the use of personalization to stimulate learning. A number of researchers have assumed that repetition is the key method for retaining memories over a long period of time. By allowing the learner to bookmark items or concepts of interest during their navigation through the learning path, personalization can make it possible to further deepen and prolong the learning process.

Learning is encouraged when a person can pursue their individual interests. Researchers distinguish between situational interest and individual interest, the first of the greater importance here, being defined as the incentive that occurs when one comes upon tasks or environments with a certain degree of ambiguity, challenge or uniqueness. The presence of incentives like surprise, complexity and ambiguity, which can be generated thanks to personalization leads to motivational states that result in curiosity and exploratory behavior.

By providing information at the right level of detail, stimulating subsequent experiences and taking into consideration individual interests as well as prior knowledge, personalization represents an excellent tool for all those educators wishing to stimulate and facilitate learning. This is why personalization techniques are often exploited in the creation of formal e-learning applications such as long-distance courses that are able to adapt to the student's level of knowledge, cognitive preferences and interests, etc.

PERSONALIZATION IN E-LEARNING

The term "adaptive" is presently one of the overused "buzzwords" in the e-learning industry, and is being associated with a quite wide range of various system characteristics and capabilities. In the context of this report, a learning environment is considered adaptive if it is capable of providing personalization mechanisms and functionalities described earlier, some of which applied to learning would be: monitoring the activities of its users; interpreting these on the basis of user models; inferring user requirements, expectations and preferences out of the interpreted activities, appropriately representing these in associated models; and, finally, acting upon the available knowledge on its users and the subject matter at hand, to dynamically facilitate the learning process. Personalization is the fashionable trend in e-learning, but is delivered using a wide variety of approaches.

Adaptations or personalization that take place at the system's interface and are intended to facilitate or support the learner's interaction with the system, without, however, modifying in any way the learning content itself is only the most obvious example of modern e-learning personalization practice. Examples of adaptations at this level may be the configuration of alternative graphical or color schemes, font sizes, etc., to accommodate user preferences or the reorganization of interactive tasks at the syntactic level of interaction.

Adaptive course delivery constitutes the most common and widely used set of adaptation techniques applied in learning environments today. The term is used to refer to adaptations that are intended to tailor a course to the individual needs of the learner. The idea is to optimize the fit between course content and individual user characteristics or requirements, so that the most effective learning result is obtained, while, the time spent for learning is minimal. In addition to time and effort economy, major factors behind the adoption of adaptive techniques in this context include: compensating for the lack of a human tutor, improving subjective evaluation of courses by learners, etc. The most typical examples of adaptations in this category are: dynamic course restructuring; adaptive navigation support; and adaptive selection of alternative fragments of course material.

Some contemporary systems also provide adaptive support in learning processes that involves communication between multiple persons and potentially, collaboration towards common objectives. Such solutions emphasizes the importance of collaboration, cooperative learning and communities of learners. Adaptive techniques can be used in this direction to facilitate the communication and collaboration process or ensure a good match between collaborators.

Another thing is that there are many organizations, consortia, etc., that are working on e-learning standards. For instance organizations like the Dublin Core Metadata Initiative, the IEEE, the IMS Global Learning Consortium, the Alliance of Remote Instructional Authoring and Distribution Networks for Europe, the Aviation Industry CBT Committee, the Advanced Distributed Learning Initiative, etc. are dedicated to, or have committees and working groups active in, the establishment of e-learning standards. The e-learning standards and specifications that have the greatest importance in the context of e-learning personalization process are IMS, ADL SCORM, and the AICC.

Current standards and concepts for educational metadata focus on content-centered approaches and models of instructional design. Scenarios that concentrate on how to structure and organize access to learning objects are mirrored in concepts such as content packaging. Standards focus on search, exchange and re-use of learning material, often called content items, learning objects or training components. The Learning Object Metadata specification, in particular, aims at metadata to facilitate the generation of consistent lessons composed of de-contextualized and distributed learning objects (e.g., consistence in the level of difficulty). Its vision is to enable computer agents to automatically and dynamically compose personalized lessons for an individual learner. The IMS Learning Design specification goes a step further, by providing a conceptual model that enables authors to describe processes and activities including social interaction. Today, most advanced examples of adaptive learning environments that extend existing standards to support adaptive course delivery include OPAL, OLO and KOD. OPAL² delivers content personalized to the learner's cognitive and presentation learning preferences using aggregation models based on ADL SCORM. One of the most important features of SCORM is that allows the instructional content designer to specify sequencing rules and navigation behavior while maintaining the possibility of reusing learning resources within multiple and different aggregation contexts. Therefore, learning objects may be structured depending on several personalization issues, ranging from student preferences to instructional designer and teacher teams expertise. The OLO³ and KOD⁴ both address the topic of extending the metadata that accompanies "packaged" learning objects, with the intention to facilitate adaptation. Although the projects take considerably different routes, they are largely motivated by the same objective, to supplement the "traditional" metadata with additional elements that are vital when one is to decide upon, and apply course-oriented adaptations. Furthermore, both projects attempt to "integrate" adaptation metadata with the traditional course information.

MAIN PROBLEMS OF PERSONALIZATION IN E-LEARNING

The wide perspective challenge in contemporary personalization practice is that resulting from the fact that very few decent research projects have been made to verify the actual positive impact of personalization on e-learning. Even though the advantages of the personalization applied to e-learning seem obvious, no decent report shows the actual verifiable statistics or metrics that would prove the positive impact of personalization.

Currently there are numerous systems that employ adaptive techniques to enable or facilitate different aspects of learning. An observation made over the related literature is that a gap appears between commercial, standards-based e-learning, and adaptive learning environments, with little, if any, standards compliance. It is usually argued that this breach is, in part, due to the lack of sufficient support for adaptive behavior in existing e-learning standards. Awareness of this problem has given incentives to several research efforts, aimed at standardizing as much of the adaptation modeling process as possible, usually on the basis of existing standards. The reuse of existing e-learning standards in the context of adaptation, is intended to facilitate the smooth and gradual transition from existing non-adaptive learning environments and courses to their adaptive counterparts.

Recognizing needs and expectations of the learners is still a challenge of the e-learning personalization mechanisms. Nowadays, available means described previously focus mainly on the electronic commerce solutions. No advanced mechanisms such as collaborative filtering, content-based or rule-based systems that would be entirely dedicated to e-learning are available.

PERSONALIZATION IN E-LEARNING: CHALLENGES

Some experts warn against the use of personalization. The main argument that personalization is over-rated, says that good basic web navigation is much more important. For example, it is helpful to consider different classes of use in the main home page of the virtual learning environment, such as the year of studies, groups of mutual

² Conlan et al., 2002.

³ Rodriguez, Chen, Shi, & Shang, 2002.

⁴ Karagiannidis, Sampson & Cardinali, 2001.

interests, children, researchers, subjects taught, detail level of the course etc. (these elements really depend on the particular situation), and to give each of these groups a relevant view of the resources that are available. Such usability issues are certainly important, and relatively cheap to address with good design, and most e-learning platforms. The challenge thus is to point the special cases where personalization is useful and desired. Further studies are needed in order to shed light on the effectiveness of personalization as a pedagogical tool, the first evaluations of early examples, have given initial help in indicating various pros and cons related to the use of personalization, however no large and detailed research has been conducted so far.

The overall feedback concerning the introduction of personalization to virtual learning environments seems to be reasonably positive. Learners access information at the level of detail desired and appreciate the various other aspects of personalization like the idea of being able to bookmark information for reference later. Certain studies have evaluated the consequences of personalization with respect to stimulating motivation and learning in a computer-based educational environment. The findings provide strong evidence that the students for whom the learning contexts had been personalized, through the incorporation of incidental individualized information about their backgrounds and interests, displayed better gains in motivation, involvement and learning than their counterparts for whom the contexts had not been personalized. However some negative aspects have also emerged. First of all, there are the issues related to the difficulty and expense of implementation. Difficulties occur mainly while designing the tools responsible for collecting the data on interests and expectations of the learners and implementing personalization algorithms. The costs of the creation of the web environment that supports personalization are always more robust than those caused by creation of the static learning environment. Therefore it is important to remember that personalization should not be implemented for the sake of it but when and because it brings added value to the particular groups of interest. Usually only if this occurs can the costs for investment and development be justified.

There have been further questions about the effectiveness of personalization. For example, the costs may be up to four times that of a normal website, around a quarter of users may actually avoid personalized websites due to privacy concerns or other reasons and only 8% are encouraged to revisit because of personalized facilities. This compares with 54% who considered fast-loading pages and 52% who rate better navigation as being important. However, other surveys indicate that personalization can be effective, for example in the field of downloadable music. For the justification of application of personalization in the open learning environments similar research should be conducted but in the e-learning field of interest among open e-learning communities.

Another issue that needs to be stressed in personalization applied to e-learning is related to standardization procedures and applications. This process is central both for content description and user profile definition using metadata. The description process can however be very time-consuming and expensive, but if it is pursued properly it allows the resources to be reused for different purposes and a user profile to be created using various different sources of information following evaluation criteria. Involvement with standards provides a good opportunity to share such knowledge.

To protect the high investment necessary for the development of adaptive learning material and environments, one has to ensure that they are not bound by particular standards and formats. This is a main prerequisite for enabling the smooth transfer of such material to new environments. Taking this concept one step further, one may need to ensure that different learning environments can interoperate in the context of adaptation. A typical exemplary setup might involve one holding an individual user's model and interaction or learning history, and another acting as a content repository.

At the same level, but worth individual mention, is the case of content discovery and aggregation. This introduces an entirely new dimension, as content "characterization" through metadata provided by its initial author or designer, can now be augmented with aspects relating to the use of that content by individuals and groups, and collected as part of the adaptation "cycle". Furthermore, by combining findings from several compatible systems, which serve the same adaptive course to a multitude of users, it would be possible to make improvements to the course itself. These could be effected either in a fully automated way, or in a "semi-automated" one, in cases where it would be preferable that no modifications are made to courses without prior approval by human experts.

MULTIPLE INTELLIGENCES APPROACH

In 1983 Howard Gardner proposed the theory of multiple intelligences, assuming that people do have different type of "intelligences": I define an intelligence as a biological potential to process specific forms of information

in certain kinds of ways. Human beings have evolved diverse information-processing capabilities - I term these "intelligences" - that allow them to solve problems or to fashion products.

According to the theory it is possible to map the broad range of abilities that humans possess by grouping their capabilities into eight comprehensive types of intelligences which can facilitate the demands for "new learning-teaching" paradigms. In broad terms the theory suggests the following comprehensive types of intelligences:

- **Verbal-linguistic intelligence.** Well-developed verbal skills and sensitivity to the sounds, meanings and rhythms of words.
- **Logical-mathematical intelligence.** Ability to think conceptually and abstractly, and capacity to discern logical or numerical patterns.
- **Visual-spatial intelligence.** The ability to perceive the visual-spatial world accurately and to perform transformations on those perceptions.
- **Bodily-kinesthetic intelligence.** Expertise in using one's whole body to express ideas and feelings and facility in using one's hands to produce or transform things.
- **Musical intelligence.** The capacity to perceive, discriminate, transform and express musical forms.
- **Interpersonal intelligence.** The ability to perceive and make distinctions in the moods, intentions, motivations and feelings of other people.
- **Intrapersonal intelligence.** Self-knowledge and the ability to act adaptively on the basis of that knowledge.
- **Naturalist intelligence.** Expertise in the recognition and classification of the numerous species of an individual's.

Cognitive and affective abilities - like the user's intellect, learning speed, spatial cognition, the ability to concentrate, or the motivation to learn - do have a strong influence on the learning process itself. This class of indicators may be mapped and reduced to the eight types of "Multiple Intelligence". On the one side, an e-learning environment could adapt to the learner's intelligences - which have to be somehow assessed and may represent the learner's competences and qualifications in a certain subject - by providing different ways to present the content, different paths through the course.

The MI theory, its potential application in e-learning and on the other hand the lack of existing models were an inspiration to start up a research and development project⁵. The project main goal is to increase e-learning effectiveness, users' satisfaction as well as to reduce drop-out rates (these issues are considered by many researchers as major e-learning weaknesses). This objective can be accomplished due to a shift from technology to learner oriented solutions and the focus on human potential and abilities. This shift requires psychological approach, where Multiple Intelligences theory developed by Howard Gardner can be a good start point, since this theory has been successfully utilized in traditional education. In the course of the project a cost-effective model for the application of MI theory in e-learning will be developed, implemented and finally evaluated.

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⁵ MIapp, more information: www.miapp.net.

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