



Analysis and Classification of Factors Contributing to Personalization in E-learning

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Abstract

The transformation brought about by digital technologies has significantly reshaped the field of education, giving rise to innovative approaches like E-learning that extend beyond the conventional confines of traditional education. One of E-learning's defining features is the concept of personalization, wherein learning approaches and content dynamically adapt to cater to the unique needs and preferences of individual learners.

This research systematically classifies the myriad possibilities of personalization within the E-learning process. The developed classification encompasses factors of creating and delivering adaptive learning objects, employing learner-centered teaching methods, and personalization grounded in individual learner data. This classification structure enables the development of practical models for personalized learning by leveraging the features of contemporary Learning Management Systems (LMS), offering tangible benefits to both learners and tutors. This research enhances the academic discourse by providing a well-organized structure that elucidates the diverse factors of personalization within the context of e-learning. By classifying and discussing various factors, the research shows the perspective of integrating modern technologies in enhancing the personalized educational experience.

Keywords: Personalization factors, Personalization preferences, Personalization of learning objects, Classification of personalized learning, Personalization in Learning Management Systems.

Introduction

Today, the need for education is relevant in all spheres of human activity. The process of learning involves reception and transformation of received information. [1]. During the traditional educational process, in most cases, all learners are provided with the same educational material. Acquisition of knowledge, consolidation and development of learning skills are uneven among learners. There are

conditional parameters that determine the learner's learning style. The current trend in the organization of the educational process is to adapt teaching styles and strategies to each learner or group of learners, taking into account their learning preferences. Preferences can be determined based on different types of research that can be conducted before or during the study. With this organization of the educational process, learning is tailored to the individual, i.e. personal needs of the learner [2],[3],[4]. Today, such organization is called personalized learning or personalization of learning. The development of the concept of personalization of education was given a powerful impetus by the introduction of technology into the educational process and the development of e-learning platforms.

The concept of personalization of learning originated in the 60s, and its adaptation to e-learning remains a relevant task today. Despite the progress of the idea of personalization of learning over the years, there is no broad and universal consensus on a single concrete definition. The 2017 US National Educational Technology Plan defines personalized e-learning as follows: Personalized learning refers to learning in which the pace of learning and approach to teaching are optimized to suit the needs of each learner. Learning objectives, instructional approaches, and instructional content (and its sequencing) may all vary based on learner needs [5].

The creation and development of powerful e-learning management system (LMS) platforms have made the implementation of high levels of learning personalization more realistic.

For example, the LMS Moodle platform possesses the capability to:

- Add a virtually unlimited number of other information fields to a wide range of existing user profile data. For example, preferred language of instruction, shift, level of previous experience, etc.
- Group users into clusters according to different criteria determined by the specifics of the learning process. For example, group, stream, profile data, etc.
- create a variety of learning resources and activities.
- Automate the management of the educational process and monitoring of various statistical data.

Although there is no single universally accepted definition of eLearning personalization, there is general consensus on the core concepts and principles. Our vision of personalization of e-learning implies that the personalization of the learning process is an educational process where the content construction, delivery, and teaching methods are adapted taking into account the personal data and preferences of an individual learner or group of learners (Fig. 1).

A **learner's personal information and preferences** on e-learning platforms can be reflected in the form of a profile. A profile is generally a set of informational fields about users registered on an e-learning platform. Data placed in the fields may contain the following information:

- About the user's personal data
- About interests and goals (preferences)
- About the form and location of education

- About previous knowledge and experience.

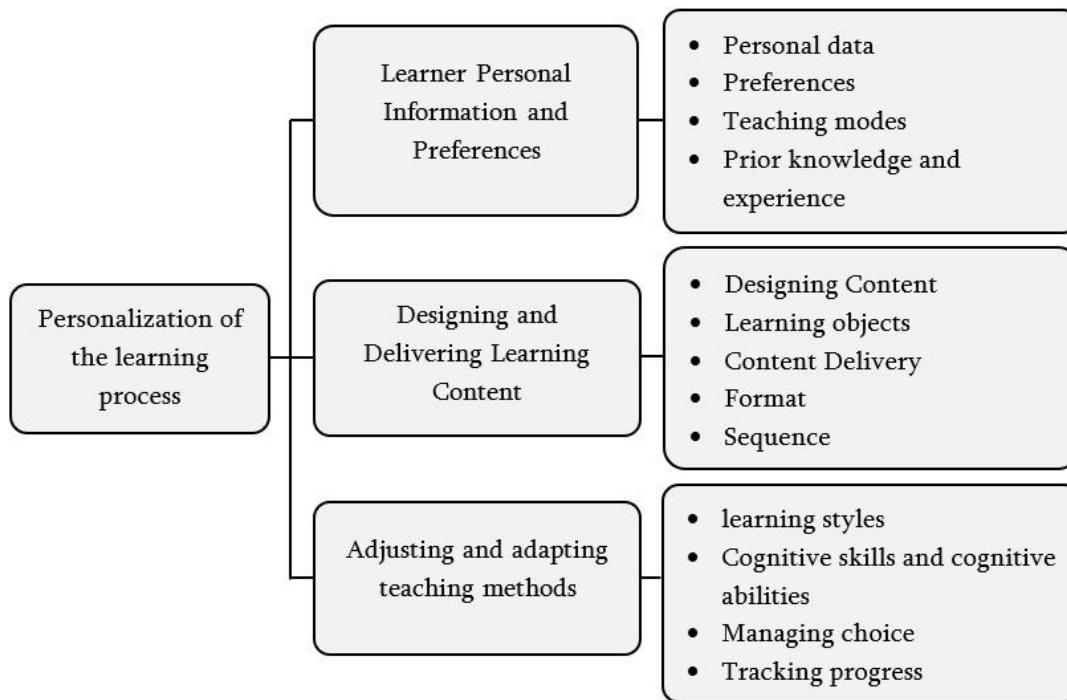


Fig. 1. Components of personalization of the educational process

Learner **personal data** refers to the specific information that identifies an individual learner. This can include their full name, date of birth, contact details, demographic information, and potentially sensitive data such as gender, ethnicity, and more.

In personalized e-learning, learner **preferences** are extremely important in shaping their learning experience. Tailoring educational content to their personal factors can significantly improve learner engagement, motivation, and overall learning outcomes. By understanding the interests and goals of learners, learning objects can be provided tailored to them using modern e-learning platforms, making the learning process more meaningful and effective.

Learners often have specific expectations from personalized e-learning. Their requirements are mostly related to flexibility, engagement, customization and more.

Importantly, the effectiveness of personalized e-learning depends on meeting these requirements and meeting the individual needs of learners. Different learners may prefer different factors (aspects), so a comprehensive approach is needed.

With personalized strategies and the powerful functions of modern LMSs, it is possible to create a motivating learning environment.

Teaching mode - The selection of teaching mode is influenced by specific educational objectives, the core nature of the subject, the preferences of the instructor, and the requirements of the learners.

According to the forms, teaching is conventionally divided into the following types: traditional face-to-face teaching, online teaching and hybrid teaching.

Face-to-face learning, also known as traditional classroom learning, refers to a mode of instruction where the teacher and learners gather in the same physical location to facilitate learning through direct, in-person interaction. In this form of teaching, direct interaction and communication

take place in real-time, allowing for immediate feedback, discussion, and engagement between the instructor and the learners.

While face-to-face teaching has long been the traditional approach to education, advancements in technology have expanded the range of teaching methods available. As a result, face-to-face teaching now exists alongside various blended, online, and hybrid learning approaches that combine both physical and virtual elements.

Online learning, also known as e-learning, refers to a mode of instruction where educational content is delivered primarily or entirely through digital technologies and the internet. In online learning, learners and instructors do not need to be physically present in the same location. This approach offers flexibility in terms of when and where learning takes place.

Online learning comes in various forms, from fully online degree programs to short courses, webinars, and Massive Open Online Courses (MOOCs).

Hybrid learning, often referred to as blended learning, is an educational approach that combines traditional face-to-face learning with online or digital learning methods. In a hybrid learning environment, learners simultaneously participate in face-to-face classes and online activities. This approach aims to take advantage of both traditional learning and modern technology to create a more flexible and dynamic learning experience [4, 7].

Prior knowledge and experience - Learner experiences can vary greatly depending on factors such as education level, prior experience with technology, and more. Overall, each learner's unique experience is influenced by a complex combination of personal, technological, and socioeconomic factors.

Prior knowledge levels refer to the existing knowledge, skills, and understanding that a learner possesses before beginning a particular course or learning experience. Prior knowledge can greatly influence how easily a learner grasps new concepts and connects them to what they already know. Learners with higher prior knowledge might find it easier to understand complex topics, while those with limited prior knowledge might require more foundational instruction. Effective e-learning strategies must take this factor into account to provide them with an inclusive and personalized learning experience.

Diverse Learning Experiences - Learners may have a variety of learning experiences that shape their educational background and preferences. This experience can vary greatly depending on factors such as age, previous education, and personal circumstances.

These varied learning experiences can influence learners' readiness and adaptability when transitioning to a personalized e-learning environment. Effective personalized e-Learning platforms must take these differences into account to provide a personalized and engaging learning experience.

Designing and delivering learning content - In personalized learning, it is extremely important to design and deliver learning content with learner preferences and personalization features in mind. For example, content delivery format, time and date, learner learning pace, grading system, and various other relevant parameters. In the case of a traditional learning course, due to the wide variety of customization options, it is necessary to have multiple versions of the same course. In many cases, the

number of such highly customized versions is very large. Moreover, if the learner's preferences change during the teaching process, it is practically impossible for the teacher to be able to build the necessary learning course versions in real time and deliver them to the appropriate recipient. This is why it is impossible to realize a high level of personalization in the case of a traditional learning process. It is technological learning that has given rise to the possibility of increased levels of personalization. Modern LMS and intelligent systems functions/engines are being explored to create highly personalized learning courses. The main factors are the construction of learning content focused on learner preferences, the development of learning objects, the formats and sequence of delivery of learning content.

Designing Content - Designing educational content involves many steps. Artificial intelligence (AI) techniques play an important role in the complex process of designing content for personalized e-Learning.

Methods of artificial intelligence, machine learning, and data analysis are used to develop and optimize recommendation systems. In turn, recommender systems help course designers and educational institutions shape content. There are truly innovative personalized e-learning systems based on various technologies and methods, such as recommender systems, case-based planning, cross-ontology, and others.

Learning objects - A learning object is an independent unit of educational content that can be used to guide learning and teaching. It is designed to be modular and reusable, with a specific learning goal or objective in mind.

The concept of learning objects emerged as a response to the need for more efficient and flexible ways of teaching and learning. Learning objects are structured to be easily repurposed and integrated into various educational contexts.

Modern learning management systems have the ability to create a variety of learning objects. These objects can be conventionally divided into learning resources and learning activities. For example, in LMS Moodle, learning resources are book, file, URLs, etc., and activities are assignments, chat, forum, glossary, lesson, quiz, SCORM, survey, wiki, and others.

Content Delivery Format - E-learning content can be delivered in various formats to cater to different learning styles and objectives. The choice of delivery format depends on the content itself, the target audience, and the desired learning outcomes. For example, some learners find it easier to learn by watching a video, while others prefer a PDF or PPT file. Providing a variety of learning objects, such as text, video/audio, images, infographics, and other formats, leads to a change in the quality of interaction.

Sequence - The sequence of delivery of learning objects in personalized e-learning may vary due to several factors: learner preferences, prior knowledge, course, subject specifics, learning objectives, etc.

Modern LMSs have functions for managing access to learning objects that allow you to control access to each object or group of objects according to various criteria. For example, in Moodle, such

criteria can be combinations of activity completion, date and time, grade, groups and clusters, user profile, and/or their logical functions.

Functions for managing access to the mentioned learning objects significantly expand the possibilities of creating personalized training courses [6].

Time and date play important roles in the context of personalized e-learning, influencing various factors of the learning experience. The sequence and time of learning objects can be dynamically changed depending on the needs and abilities of learners, which makes the learning process as personalized and effective as possible. It affects the availability, pace, and other time-related needs of teaching. Effective time and date management can improve the overall learning experience.

Learning pace is a crucial factor of personalized e-learning, as it allows learners to progress through the material at a speed that suits their individual needs and abilities. With this teaching approach, learners have the ability to manage their own learning processes to some extent. By accommodating individual learning paces, learners can engage with the material at a rate that maximizes their comprehension and retention, which is a prerequisite for effective learning.

Grading in the context of personalized e-learning involves the assessment and evaluation of learners' performance and understanding of the course material. While the specific grading system and criteria can vary depending on the educational institution, program, or platform. In personalized e-learning, grading should align with the overall educational goals and the individualized learning paths of learners. It should provide a meaningful reflection of each learner's progress.

Adjusting and adapting teaching methods - In personalized e-learning, **learning styles** are defined as the preferred ways in which individual learners process and absorb information. These styles encompass various cognitive, sensory, and psychological factors that influence how learners best understand and retain new knowledge. Understanding a learner's preferred learning style helps educators and e-learning platforms tailor the learning experience to match their unique needs and preferences. In personalized e-learning, the goal is to identify each learner's dominant learning style or styles, as well as any preferences for multimodal learning.

It's important to note that learning styles can be fluid, and individuals may have a mix of preferences. Therefore, personalized e-learning should aim to provide flexibility and adaptability in content delivery to accommodate learners with varying styles and to support their growth and development in different learning contexts.

Cognitive skills and cognitive abilities - Personalized e-learning should consider both cognitive skills and cognitive abilities. Their role is important in developing an effective and personalized learning experience.

Managing choice in personalized e-learning is a crucial factor of designing effective online education programs. While choice can enhance engagement and motivation, it must be managed effectively to ensure that it aligns with learning objectives and does not overwhelm learners. Rather than being controlled by a pre-assessment, learners can create their own personal learning paths based on their interests and self-esteem. Balancing freedom within a structure is one of the important factors in creating successful personalized learning.

Tracking progress - In personalized e-learning, learning tracking is extremely important to monitor learner progress. Using this lever in the learning process involves monitoring various factors of the learner's performance to assess progress and make any necessary changes. This helps the learner understand their strengths and weaknesses. This allows the course designer to effectively tailor the learning experience to the learner as well as evaluate program delivery.

Conclusion

Thus, the paper describes and classifies the versatile possibilities of personalization for the e-learning process. Factors of educational content design and delivery, learner-centered teaching methods, and personalization based on individual learner data are discussed. Based on this classification, it is possible to build real models of personalized learning using the functions of modern learning management systems (LMS). This research contributes to the scholarly discourse on e-learning by offering a structured framework for comprehending the multifaceted nature of personalization. By classifying and discussing various factors, the study shows how promising and feasible the use of modern technologies is to deepen the personalized learning process.

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პერსონალიზებული ელ. სწავლებაზე მოქმედი ფაქტორების ანალიზი და კლასიფიკაცია

გიორგი თანდილაშვილი¹, დავით კაპანაძე², თალიკო ჟვანია³, მზია კიკნაძე⁴ საქართველოს ტექნიკური უნივერსიტეტის დოქტორანტი, ²საქართველოს ტექნიკური უნივერსიტეტის პროფესორი, ³საქართველოს ტექნიკური უნივერსიტეტის პროფესორი, ⁴საქართველოს ტექნიკური უნივერსიტეტის პროფესორი

აბსტრაქტი

ციფრული ტექნოლოგიების მიერ განხორციელებულმა ტრანსფორმაციამ მნიშვნელოვნად შეცვალა განათლების სფერო, წარმოშვა ინოვაციური მიდგომები, როგორცაა ელექტრონული სწავლება, რომელიც სცილდება ტრადიციული განათლების ჩვეულ საზღვრებს. ელექტრონული სწავლების ერთ-ერთი განმსაზღვრელი მახასიათებელია პერსონალიზაციის კონცეფცია, რომლის დროსაც სასწავლო მიდგომები და შინაარსი დინამიურად ადაპტირდება ინდივიდუალური მოსწავლის უნიკალურ საჭიროებებსა და პრეფერენციებზე.

ნაშრომში მოცემულ კვლევაში წარმოდგენილია კლასიფიცირებული ელექტრონული სწავლების პროცესში პერსონალიზაციის შესაძლებლობები. შემუშავებული კლასიფიკაცია მოიცავს ადაპტური სასწავლო ობიექტების შექმნისა და მიწოდების ფაქტორებს, მოსწავლეზე ორიენტირებული სწავლების მეთოდების გამოყენებას და ინდივიდუალურ მოსწავლის მონაცემებზე დაფუძნებულ პერსონალიზაციას. ეს კლასიფიკაციის სტრუქტურა იძლევა პერსონალიზებული სწავლის პრაქტიკული მოდელების შემუშავების საშუალებას სწავლის მართვის თანამედროვე სისტემების (LMS) მახასიათებლების გამოყენებით, რაც ხელშესახებ სარგებელს სთავაზობს როგორც მოსწავლეებს, ასევე მასწავლებლებს. ეს კვლევა ასევე აძლიერებს აკადემიურ გარემოს, სადაც კარგად არის ორგანიზებული სასწავლო პროცესის სტრუქტურა და რომელიც ასახავს პერსონალიზაციის მრავალფეროვან ფაქტორებს ელექტრონული სწავლების კონტექსტში. სხვადასხვა ფაქტორების კლასიფიკაციითა და განხილვით, კვლევა აჩვენებს თანამედროვე ტექნოლოგიების ინტეგრირების პერსპექტივას პერსონალიზებული საგანმანათლებლო გამოცდილების გაღრმავებაში.

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