

Personalization of a learning environment supported by AI for vocational training based on skills required: A research proposal

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Abstract. The learning environment is an essential part of teaching and learning. Its personalization has several advantages (e.g., guaranteeing learning quality or effective learning). In vocational education, a personalized learning environment might provide training most suitable to each professional according to individual characteristics, skills, or career path. Artificial intelligence's ability to process big data can be harnessed to personalize a learning environment. This work intends to investigate the personalization of a learning environment using artificial intelligence (AI) in vocational training that can provide relevant training based on the trainees' skills required. A framework will be proposed to personalize a learning environment in this scope. Its development will follow the design science research (DSR) methodology. During the process, the survey methodology (expert interviews and focus groups) will be conducted to validate the artifact requirements and evaluate our future framework.

Keywords: *Artificial intelligence, Framework, Learning environment, Personalization, Vocational training*

1 Introduction

Human capital is an asset within organizations. The performance of this capital can help organizations position in their markets. Semenova et al. (2021) emphasized "the importance of education and training as the main components contributing to the growth and development of human capital" (p. 3).

Aligned with this opinion, professional training is essential for any organization to boost human capital. The evolution of technology and the digital environment has brought distinct solutions and new ways for organizations to provide professional training.

With an understanding that to be successful in their professions or roles, professionals need specific competencies that can be gained through the training (Semenova et al., 2022).

In this perspective, we emphasize the point of view that every individual has different needs and preferences for learning. The concept that one subject or plan can serve all learners is considered outdated, and the learning requirements cannot be indistinguishable for a set of learners (Bhutoria, 2022). In the training systems design, each individual's particular needs have to be considered (Aplugi & Santos, 2022).

Personalization in any learning type is today's demand and is possible through technology usage (Bhutoria, 2022), specifically the "personalized learning software systems" (Ismail et al., 2023, p. 3). These systems adapt how the learners access digital content in digital environments.

Previous studies explained how emerging or recent technology (e.g., artificial intelligence) could assist students in personalized learning concepts. The technologies offer various choices for building learning styles and other alternatives to reduce the high cost of education (Mhlongo et al., 2023; Ambele et al., 2022).

The intelligent system and automation provided through technologies support personalization in a learning environment (i.e., the learners are guided to tailored learning), which can guarantee and increase education quality. This quality refers to the possibility that the learners can acquire the knowledge related to their needs and improve the outcomes, leading to effective, efficient, and successful training processes (Maghsudi et al., 2021; Ambele et al., 2022; Yanjin et al., 2023).

Even though various studies, for example, Vakhidova et al. (2023) or Aplugi and Santos (2022), evidence the importance and advantages of learning personalization, its implementation still presents challenges and gaps to overcome.

Some authors (Table. 1) mentioned the lack of personalization in learning environments to guide or help the learners during their learning process. One of the studies indicated that the frameworks are needed to facilitate the adaptation of learning to learners' characteristics and demands (described in Section 2).

Considering the problem explained in Section 2, we will investigate the personalization of a learning environment with artificial intelligence (AI) support in the vocational training context. Through this personalization, each trainee might receive the training needed and relevant in determined skills acquisition to perform their profession.

The use of AI can support personalization by identifying (i.e., through data analyses) the determined skills needed to perform a profession. It might facilitate monitoring during the training process (or provide real-time support).

For this research proposal, we revised the review papers to search for scientific evidence about the problem presented and to answer our research questions superficially. The papers obtained can lead to understanding the importance of personalizing the learning environment (LE), the existing frameworks and technologies to personalize an LE, and the use of AI technologies for learning environment personalization.

To solve the problem and propose a solution, we will use the DSR methodology to design, demonstrate, and validate a framework for personalizing a learning environment supported by AI in an enterprise context.

This proposal is structured as follows: Section 2 presents the research problem, objective, and research questions; Section 3 presents the literature review based on review papers; Section 4; presents the research methodology; Section 5; describes our plan for

future work; Section 6 presents the ethical consideration; and Section 7 presents the final considerations.

2 Research Problem, Objective, and Research Questions

2.1 Research Problem

The problem that motivates our research is the **need for a personalized learning environment adapted to training needs in an enterprise context**.

We found the present problem through the analyses of previous studies that identified various gaps in learning environment personalization.

Yanjin et al. (2023) described that one of the challenges to implementing personalization in vocational education is the lack of "differentiated instructional strategies and resources" in the traditional model (i.e., traditional learning environment) (p. 1).

Murtaza et al. (2022) identified the challenges regarding the diverse frameworks (e.g., for tracing learner-level knowledge, a guide to update a learner's preference, and recommendations based on preference). Following the authors, updating a learner's preference can facilitate the adaptation of the training model based on the learner's knowledge, preference, or need. More research is needed to overcome the challenge of focusing on real-time personalization provision.

Maghsudi et al. (2021) defended that the traceability of a learner's knowledge is essential to provide personalization in the learning process. The main challenge is the loss or impairment of the learner's information in the knowledge tracing (KT). The authors suggested further study to overcome this challenge (i.e., trace without loss).

Other challenges and gaps can be seen in Table. 1, which summarizes some gaps and future research recommendations by two authors most aligned with our research.

Table. 1. Gaps/Challenges in LE Personalization

Challenges/gaps	Research recommendation	References
Trace learner-level knowledge	Framework	Murtaza et al. (2022)
	Traceability without learner's information loss	Maghsudi et al. (2021)
Skills identification for professional development	Identify the skills needed for a profession	Maghsudi et al. (2021)
Training model based on the learner's knowledge, preference, or need	Learning environment personalization in real-time	Murtaza et al. (2022)
Trace learner-level knowledge	Framework	Murtaza et al. (2022)

Various frameworks referenced in Section 3 have proposed the personalization of LE that can guide the learners in their learning process by determining the tailored content, learning resources, or tasks according to their knowledge level and learning style.

However, we did not find a framework to personalize an LE that enables the learners to learn the subjects and gain competencies according to their current knowledge of a specific profession or role.

2.2 Objective

In order to resolve the problem described in the previous section, this research intends to investigate the personalization of a learning environment with artificial intelligence in the context of vocational training.

The aim is to **personalize a learning environment in the vocational training context supported by AI that can provide the relevant training based on the trainees' skills required.**

Considering the gaps presented in Table 1 (e.g., LE personalization in real-time), our investigation will focus on the personalization of an LE supported by AI to guide the trainees in real-time based on their knowledge of a specific profession or role. Then, the system identifies the most fundamental resources (e.g., learning subjects or modules) to gain the skills needed to perform a profession or role.

2.3 Research Questions (RQs)

To reach the investigation objective, we formulated three main RQs as follows:

1. What is the importance of personalizing a learning environment within an enterprise context?
2. What frameworks exist for personalizing a learning environment?
3. How can a vocational training learning environment be personalized with AI resources?

3 Literature Review

The information extracted and presented in this section is a preliminary review based on review papers to address our RQs presented in section 2.3.

The researchers have discussed and reported the lack of approaches centered on the learners in the traditional education system. It is fundamental to consider the individual value of each learner, providing a more personalization in the education system to meet learners' needs.

Personalization can be assumed as the basic point of quality education, in which the learning resources are available to guide learners individually to the most suitable path in the learning process (Ambele et al., 2022; Maghsudi et al., 2021).

According to Bhutoria (2022), the personalization approach in the learning system refers to "a self-motivated setup where a set of adaptive learning tools are available for the learners to adjust to their personal preferences and skills" (p. 8).

Based on the studies reviewed, Fig. 1 illustrates various aspects related to the importance of LE personalization, as explained by their authors.

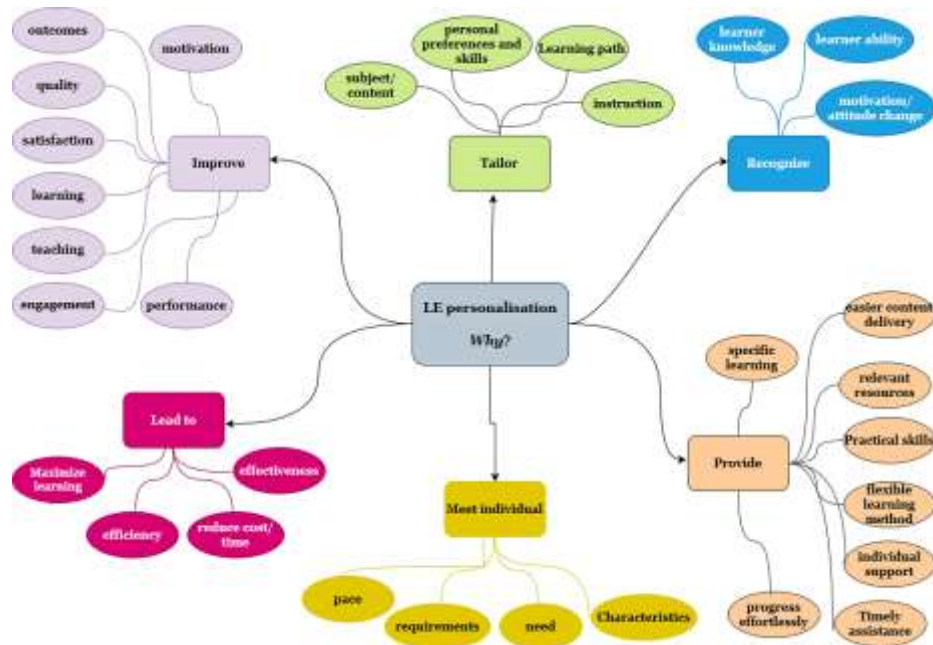


Fig. 1. The importance of the LE personalization (Created by author)

A personalization approach can help create the learning path, giving trainees a chance to follow the training based on their knowledge and the path desired (Aplugi & Santos, 2022). Moreover, it provides "flexible and diverse instructional content and methods based on student's interests, abilities, and learning styles" (Yanjin et al., 2023, p. 2), leading to improvement of learner's performance (Volodymyrivna et al., 2022).

At present, the acceleration of innovation and disruption in enterprises' procedures and the technologies used require employees to upskill continuously. These scenarios lead to an increase in training needs that provide practice skills according to demand. Thus, personalized training becomes essential (Pavitra & Agnihotri, 2023) to accelerate the training process, reduce cost, shorten the learning time (Aplugi & Santos, 2023), and gain the practical skills that can be applied directly at the workplace (Yanjin et al., 2023).

The learning environment of vocational training that provides resources to define the training objectives clearly will lead to high learning efficiency and motivate the learner (Xue-jun et al., 2021).

Mhlongo et al. (2023) enumerate the diverse technologies that might be harnessed in designing a personalized learning environment, such as big data, learning analytics, and AI. Based on these technologies, previous studies have suggested frameworks for personalization in the learning process and LE.

Volodymyrivna et al. (2022) presented a model framework of narrative overview (Fig. 2) that consists of four elements: content, intelligent agent, teaching method, and communication.

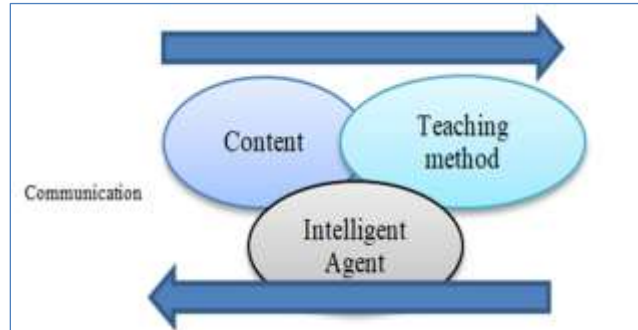


Fig. 2. Framework of narrative overview
(Source: Volodymyrivna et al., 2022 p.4)

Murtaza et al. (2022) developed an example of an intelligent e-learning system framework (Fig. 3). Five modules (data, adaptive learning, adaptability, content and assessment delivery, and recommender) are part of this framework.

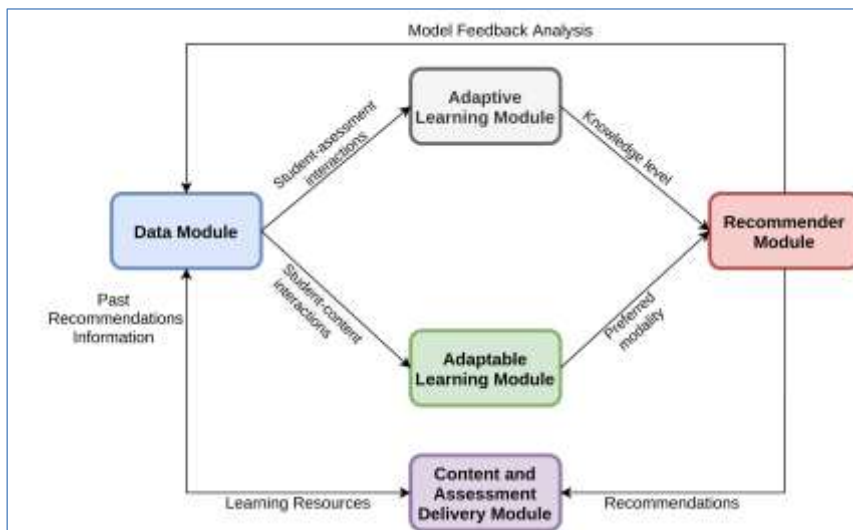


Fig. 3. Framework for personalized e-learning
(Source: Murtaza et al., 2022)

A framework proposed by Xue-jun et al. (2021) focused on personalized learning systems for military vocational education (Fig. 4).

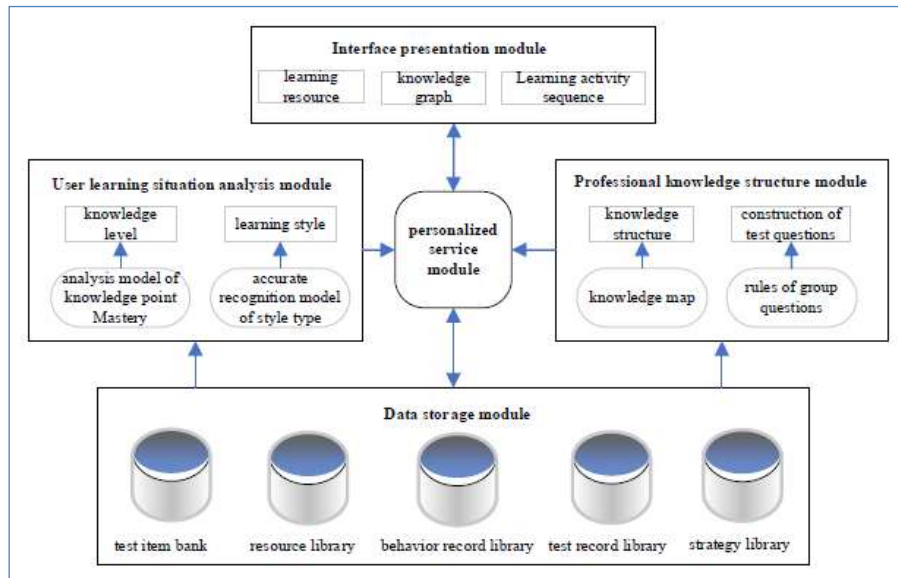


Fig. 4. Framework of personalized learning system for military Vocational Education
(Source: Xue-jun et al., 2021)

The design principle of this framework used big data to identify the training characteristics of learners (based on knowledge level and learning style) and determine the content, resource type, and activity sequence.

Ismail et al. (2023) emphasized the user model as an essential element in LE personalization, where the learner information (e.g., learners' behavior or their inputs) can be identified or predicted. The outputs of the information analysis in the user model section are based on personalization, tailoring the resources individually. Thus, personalization is possible if the user model is presented in the LE structure or framework.

To create a user model, the authors considered four keys: "facets of the user that are to be modeled; data that can be used to build the model; data collection tools; and user modeling approach" (p. 12).

Previous studies have pointed out that the characteristics and qualities of AI (e.g., automation and data analytics) can be harnessed to support and personalize a learning environment. One of the most important values of AI in education is its capacity to personalize education (i.e., the learning environment) Maghsudi et al. (2021). By identifying learners' characteristics, behaviors, and needs effectively, AI can provide personalized learning and support. Furthermore, AI can identify specific skill demands and then recommend development directions (Yanjin et al., 2023).

The review conducted by Aplugi and Santos (2022) reported that the application of AI in a learning platform can help to improve learning experiences and facilitate the learning process through resource personalization, adjust the content according to the learner's need, or search and provide fitted content based on learners' data.

The training systems supported by AI can forecast future careers based on data analysis of job trends, enabling advice on learning planning for a specific career path.

Matching trainees' skills and job market demands can minimize the gap between companies' requirements and education (Rosyadi et al., 2023; Yanjin et al., 2023). In this way, the relevant training can support employees in being prepared for their growth and future careers.

This literature review serves as the ground to describe the relevance of a personalized LE and what we need to know regarding the framework to personalize a learning environment in vocational training so that we can present our proposal.

We need a methodology to plan the design, demonstration, and validation of the framework that we will propose. We consider the DSR methodology relevant to our research (described in Section 4).

4 Research Methodology

To reach the objective of our research, which is to personalize a learning environment in the vocational training context supported by AI that can provide the relevant training based on the trainees' skills required, we will use the DSR methodology to design, demonstrate, and validate a framework that will be proposed for this purpose. According to Hevner et al. (2004), DSR is a methodology widely used in the technology and information area to create and analyze artifacts. It often focuses on examining the usefulness of an artifact and developing a solution to problems encountered within organizations. The solution could be a new artifact or an improvement to an existing artifact.

This work will follow six phases of DSR methodology (Fig. 5) explained by Peffers et al. (2007), consisting of problem identification and motivation; objectives of a solution; design and development; demonstration; evaluation; and communication.

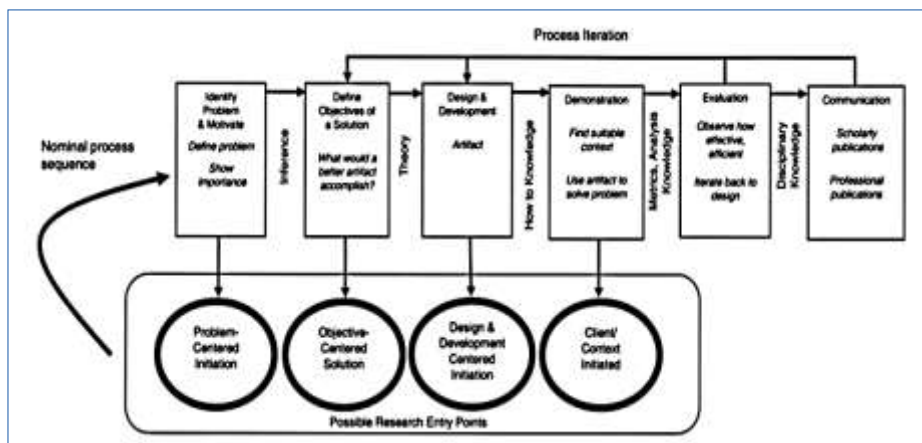


Fig. 5. Phases of DSR (Source: Peffers et al., 2007)

This research proposal is based on literature, where we found the gap that justifies our research problem and the objective described in section 2.

An in-depth literature review, which refers to a systematic literature review (SLR), will be conducted so that we can further define the artifact (i.e., our future framework) requirements.

The interview technique will be applied to validate these requirements for personalizing a learning environment in the vocational education context. We will consider the experts in the vocational training area as our participants.

SLR and interview results will be the keys to proposing a framework and its design and development.

To ensure that our framework proposal can be implemented, we will demonstrate how our framework works in a real learning environment in an enterprise context.

After the demonstrations, the focus group will be realized to evaluate our framework and the eventual redesign. We will consider the experts in the vocational training area and the trainees as our participants.

After this process, the conclusion will be taken, and the result will be communicated (papers publication).

An interview is a survey methodology technique that permits a researcher to obtain participants' points of view, opinions, or information about knowledge, experience, or explanation of ideas on a particular topic. Data is collected using unstructured and generally open-ended questions (Creswell & Creswell, 2023; Gil, 2008).

Focus group is a qualitative interview to get perspectives and opinions from participants through unstructured and a few open-ended questions. The researcher interviews a group of participants in the same space or virtually using email or web-based platforms (Creswell & Creswell, 2023).

According to the DSR phases in Table. 2, we listed the tasks that would be realized and the expected results of our research.

Table. 2. List of Phases, Tasks, and Expected Results of Research

Phases	Tasks	Results
Identify problem and motivation	State of the art Systematic Literature Review	Problem definition Research objective A list of framework requirements
Objective of solution	Experts interview	Validation of framework requirements
Design and development	Development of the first framework version	A framework proposal (first version)
Demonstration	Application and test of the framework	Register the application results
Evaluation	Focus group to validate the framework proposed	Eventual redesign framework
Communication	Report writing	Research report Paper publication

5 Future Work

Considering the research methodology selected, the schedule of activities for this research will be based on the different phases of the DSR. In this context, the planning presents the following set of activities:

Activity 1 – State of the art: search for the recent studies about the personalization of the learning environment supported by AI and theories about the learning environment and its personalization.

Activity 2 – SLR: answers and discussion of RQs, define the initial idea and requirements of our future framework.

Activity 3 – Requirements of the framework: Survey (interview) and result analysis; interview with experts to validate the artifact requirement to personalize a learning environment in a vocational training context.

Activity 4 – Design and development: propose and develop a first version of our framework.

Activity 5 – Demonstration: application of the first version of the framework on a representative sample of the learning environment within an enterprise context (to be identified and described).

Activity 6 – Validation: using the focus group technique to validate the framework proposed.

Activity 7 – Communication: papers to be published in journals or conferences

- Paper of the SLR
- Paper of the framework demonstration
- Paper of the framework proposal
- Paper of the framework evaluation

Activity 8 – Final research report.

6 Ethical considerations

Since our project and the future framework involve the use of AI and user personal data, it is important to salient the risk and data protection. Data utilization must follow compliance to guarantee privacy (Murtaza et al., 2022).

Emphasize the Regulation (EU) 2016/679 (2016, articles 5 – 7) over personal data process and Regulation (EU) 2024/1689 (2024), focusing AI systems in vocational training and scientific research as prior cited, to guarantee the data privacy of the participants in this research we will:

- Ask for participants' consent (in a written document) regarding their data utilization.
- Inform the participants about the background and objective of our research (in a written document).
- Use data for research purposes only and avoid bias.
- Inform the participants how and which data will be collected and used and for what purposes.

- Keep the participants anonymous for the third parties.
- Minimize data collection and use what is necessary according to the research objective (e.g., the profession, role, and education level of the participant). Personal data that is not relevant to the research purposes will not be collected or stored (e.g., name, address, or other).
- Apply pseudonymization if applicable to avoid the connection of data to individuals.
- Use a house host for data storage and backup.
- Submit our project to the Scientific Commission of our University and only proceed with our research after it is officially accepted and authorized.

7 Final considerations

In this research proposal, we intend to explain how to develop a framework to allow trainees to be guided by AI in a personalized learning environment (PLE).

To do this, we will base ourselves on a literature review that explains the importance of a PLE for learners and the companies where they work.

Through personalization, trainees can follow the most appropriate path during the learning process to obtain the necessary skills and thus be able to improve their professional performance. In this way, training in a company can be more effective and guarantee the trainees' satisfaction and motivation.

The systematic literature review will be conducted to extract more information on how to personalize an LE in vocational training and how AI can help with this personalization. It will also present different frameworks that have already been implemented in similar contexts.

The result of this research will be a new Framework for the personalization of a learning environment supported by artificial intelligence, which provides training according to the competencies required based on the trainee's knowledge of the performance of a profession or function.

For the detailed investigation, the DSR methodology will be applied and followed, and the artifact will be designed, demonstrated, and evaluated.

The framework that will be proposed can be used in vocational training systems to improve the learning process.

We have considered limitations at this stage, such as the fact that we don't yet know the requirements for developing a framework and where to demonstrate and evaluate the framework that will be proposed.

Another concern is the agreement of the participants. Since user data is involved in working with the AI approach, it may be difficult to find participants to demonstrate and evaluate our future framework.

It is intended that the result of this study can help the development of employees in companies, with access to training tailored to their needs and personalized to the performance of their duties.

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