

Game-based Support for Vocational Teachers' Competence Reflection in Professional Development Search

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Abstract: Vocational teachers are expected to develop digital competences continuously. However, when they search for professional development opportunities, they are confronted with keyword-based search interfaces on professional development platforms that offer little guidance and rarely address their needs as adult learners. As a result, identifying learning pathways for professional growth can be difficult, especially for teachers with limited time and heterogeneous prior experiences with digital teaching. The joint project ELMeKS.digital develops a game-based entry point for vocational school teachers to search for professional development opportunities, framing lifelong professional learning as a self-directed, practice-oriented, and motivation-supportive process. To foster orientation and competence reflection, the platform is aligned with the *European Framework for the Digital Competence of Educators* (DigCompEdu), which structures key competence areas for teaching with digital technologies. This allows the platform to connect game-based interaction with competence-oriented self-reflection and personalised recommendations. Across these areas, teachers engage with mini-games that represent professional situations and digital teaching practices, for example, by identifying design flaws in presentation slides or reflecting on classroom-related digital decisions. Based on players' performance across competence areas, the system generates tailored professional development recommendations. The paper presents the design rationale of the platform and findings from usability tests and think-aloud protocols with vocational teachers involved in the iterative development process. It examines to what extent game-based designs can reduce orientation problems in professional development discovery, support competence reflection and motivate teachers to engage in continuous learning. By focusing on vocational teachers as adult learners, the study contributes to current discussions on game-based learning for lifelong learning. It shows how playful, low-threshold, and competence-oriented digital environments support professional development search and help teachers navigate the professional development landscape in a more reflective and motivating way.

Keywords: Game-based learning, Teacher professional development, DigCompEdu, Competence assessment, Usability testing

1. Introduction

Vocational school teachers fulfil a dual role: while supporting trainees in developing digital media literacy, they are simultaneously required to continuously advance their own digital and pedagogical competencies (Terhart, 2011). Despite a wide range of digital and analogue professional development formats, most existing platforms still follow a traditional search logic, allowing users to filter by terms and keywords, while individual starting points, subjective needs, and different search strategies are rarely supported adequately. The challenge therefore lies less in a quantitative shortage of professional development opportunities and more in the lack of structural and design support for navigating and selecting suitable opportunities within a heterogeneous professional development landscape. While previous research has focused on digital tools and platforms for the professional development of teachers, there are still few empirical studies that systematically examine the user-centred design of digital search and selection interfaces for professional development offers.

The ELMeKS.digital project is developing a user-centred web portal that provides various ways to search for professional development opportunities. The aim is to enable teachers to access the system in a personalised way that builds on their existing experience and search strategies. This paper describes and evaluates one of three approaches to professional development search: a game-based entry point in which training recommendations are generated on the basis of an exploratory game comprising more than 20 mini-games that reflect different areas of competence. The study draws on qualitative usability testing using a prototype, supplemented by short guided interviews. In addition to usability, motivational aspects and the reflection on existing competences and potential for further development are examined in order to answer the question of how game-based designs can support vocational education and training teachers in their professional development.

The paper contributes to research on game-based professional learning search and derives implications for the user-centred development of digital professional development platforms.

2. Theoretical Background

This chapter outlines the theoretical foundations of the study. First, concepts of lifelong learning and the professional development of vocational teachers are elucidated, particularly with regard to digital competencies in educational practice. Subsequently, game-based learning is introduced as a pedagogical approach for fostering motivation and engagement within the context of lifelong learning. These perspectives form the conceptual basis for the design and evaluation of the game-based tool for identifying professional development opportunities developed within the framework of the ELMeKS.digital project.

2.1 Lifelong Learning and Professional Development of Vocational Teachers

In teacher education, professional development is generally referred to as the “third phase” following university studies and pre-service training. It constitutes the longest phase of professional qualification and is firmly embedded in the ongoing professional development of teachers (KMK, 2020; Terhart, 2011). In the educational context, continuous professional development refers to the continuation or resumption of organised learning following initial training, serving to expand, deepen, or update knowledge, skills, and competencies (KMK, 2001). According to Weinert (2001), competence encompasses not only cognitive skills and knowledge but also motivational, social, and volitional dispositions necessary for successful action in various situations. Research on teacher professionalism also distinguishes between subject-specific knowledge, pedagogical knowledge, and experiential knowledge acquired through practice (Baumert & Kunter, 2013). Existing platforms for searching for professional development opportunities typically rely on keyword-based search systems that require users to precisely formulate their search interests in advance. Furthermore, studies show that continuing professional development opportunities vary considerably from region to region and are not always sufficiently tailored to the specific needs of vocational schools (Bylinski, 2009). However, if their own competencies and needs are not explicitly known, teachers encounter limitations (Richter et al., 2020; Weber et al., 2024). By providing support for personalized guidance and competency reflection, such platforms can help lower the barriers to participation in lifelong learning. The following project pursues this very approach by piloting a game-based method for searching for professional development opportunities.

2.2 Game-based Learning for Lifelong Learning

Game-based approaches can increase motivation and engagement and thereby support active learning processes. Research commonly distinguishes between gamification and game-based learning (GBL). While gamification refers to the use of game elements, such as points or badges, in non-game contexts, GBL uses the game itself as the primary learning environment, in which learning objectives are directly embedded within the gameplay (Deterding et al., 2011). In the context of professional development search, this distinction is important because the ELMeKS.digital approach does not simply add reward mechanics to a conventional interface, but uses mini-games as a structured means of competence reflection and orientation. GBL environments are typically characterised by problem-oriented tasks, clear goals, immediate feedback, and active participation. These structures can support engagement and stimulate cognitive learning processes (Fotaris & Mastoras, 2019). Previous studies suggest that GBL environments can positively influence motivation and learning outcomes, provided they offer meaningful challenges and structured feedback (Wouters et al., 2013). One of the reasons why GBL may be effective is that it can induce a state known as ‘flow’. This describes a state of deep concentration and intrinsic motivation that occurs when challenges and individual abilities are in a balanced relationship with one another (Csikszentmihalyi, 1990). Studies also suggest that engagement and the perceived challenge are closely linked to learning experiences in digital games (Hamari et al., 2016).

2.3 The ELMeKS.Digital Project

The *ELMeKS.digital* project aims to strengthen the digital skills of teachers at private vocational schools in the fields of social pedagogy, health/nursing, and physiotherapy in Saxony (ELMeKS.digital, 2025). Private vocational schools play a key role in ensuring a supply of skilled workers in sectors such as healthcare, social services, and nursing. Their teaching staff often includes career changers, practitioners from the respective professional fields, and teachers without traditional pedagogical training. Consequently, their pedagogical, media-related, and professional backgrounds as well as their continuing education needs are highly diverse.

Analyses of existing search portals show that teachers’ prior competencies and heterogeneous starting points are rarely taken into account—even though these significantly shape the search process (Bundesministerium für Arbeit und Soziales, 2025). The platforms continue to rely on conventional, filter-based logic that assumes a certain level of prior knowledge and search proficiency. Furthermore, recommendations often remain vague and are usually directed at a broad audience rather than specific user groups. ELMeKS.digital is therefore testing

alternative pathways to continuing education offerings to increase their relevance, guidance, and motivational fit for teachers' professional daily routines.

2.4 System Architecture

The ELMeKS.digital web portal is designed as a modular system that follows a user-centred approach and accommodates different search strategies. It offers three entry points to professional development search: (1) a chatbot, (2) an inspiration area, and (3) a game-based approach. Depending on their needs and search preferences, users may rely on one entry point only or combine several pathways. All approaches ultimately lead to personalised professional development recommendations based on users' needs, interests, or competence profiles.

Figure 1 illustrates the overall architecture of the portal, the relationship between the three entry points, and the evaluation framework applied in the present study.

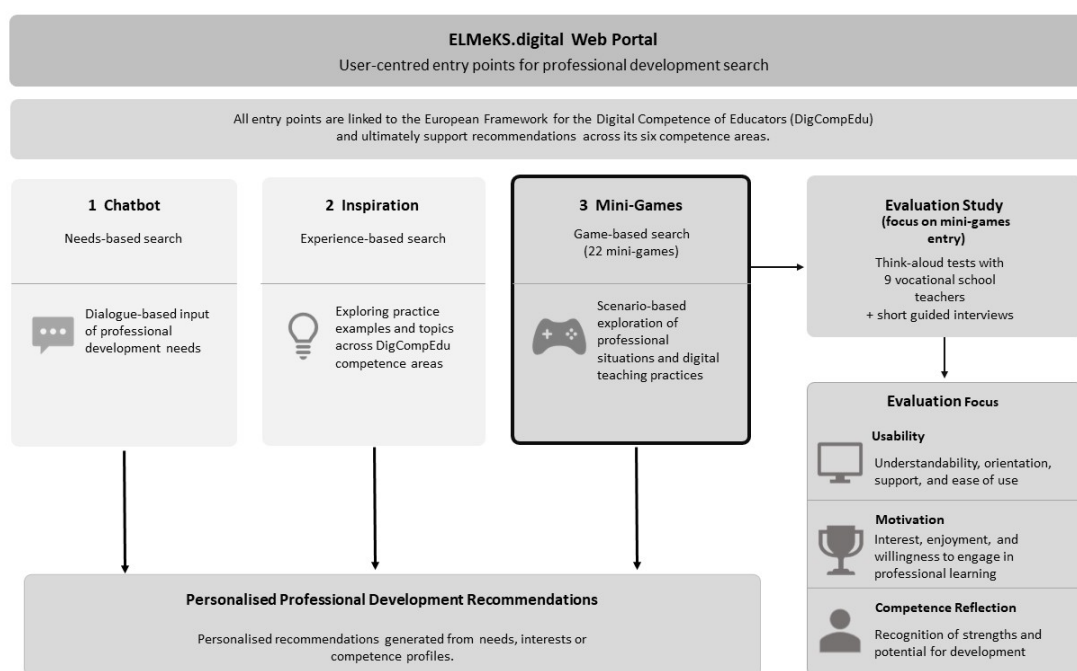


Figure 1: Architecture of ELMeKS.digital web portal and evaluation focus

The game-based approach (mini-games) is the focus of this study and is described in more detail below.

The game-based entry point guides users through a school map that serves as the central navigation interface for a series of missions and mini-games. The different locations on the map correspond to the six competence areas of DigCompEdu (Redecker, 2017). Within each competence area, users interact with fictional game characters who introduce specific tasks related to the respective competence domain. In total, the system comprises 22 mini-games linked to DigCompEdu sub-competences and designed to make users' existing strengths and development needs more visible. At the time of this evaluation, only one mini-game had been implemented as part of the working prototype to test the game logic and the functionality of an integrated skills test. By combining playful interaction with competence-oriented reflection, this entry point is intended to lower barriers to professional development discovery and to appeal particularly to teachers who may not be attracted by conventional search interfaces. Compared to the other entry options, the game-based approach places greater emphasis on motivation, curiosity, and reflective engagement.

2.5 Mini-game Example

The evaluated mini-game is located within the DigCompEdu competence area *Digital Resources*. Participants are presented with a four-slide PowerPoint presentation that contains deliberately embedded design flaws. These include insufficient contrast, inconsistent formatting, and other issues related to the visual and pedagogical quality of presentation materials. The task is to identify and correct these issues in order to improve the overall quality of the resource.

Interaction is organised through the selection of specific slide elements that require modification. Users then choose suitable adjustments from a set of predefined options, such as improving contrast, adapting the layout, or correcting content-related issues. A progress bar at the top of the interface indicates how many corrections are required both for the current slide and for the overall task. In total, ten corrections are distributed across four slides.

Upon completion, users receive a performance summary showing correctly identified issues. This output contributes to a broader competence profile within the system. In the overall portal design, the results from this mini-game are combined with outcomes from other missions in order to generate personalised professional development recommendations. These recommendations are intended to support targeted upskilling within the respective DigCompEdu competence area. Accordingly, the mission not only raises awareness of quality criteria in digital teaching materials, but also supports structured reflection on individual competence development needs.

3. Methodology

The present study is methodologically grounded in a Human-Centred Design (HCD) approach. HCD emphasises the early involvement of end users, iterative system development based on user feedback, and the consideration of authentic usage contexts. This approach is particularly suitable for the development of digital systems whose acceptance and usability depend strongly on the needs and experiences of the target group. Accordingly, the ELMeKS.digital platform was developed and evaluated through iterative cycles involving experts as well as vocational school teachers as representative users.

3.1 Research Design

The evaluation of the game-based approach was conducted on-site in a controlled testing environment as part of the platform's iterative development cycle. Participants interacted with a functional prototype of the platform. Accordingly, the evaluation took an exploratory approach. The primary goal is to identify existing problems in the use case. Initial impressions from users and conclusions for the iterative further development of the prototype are being gathered. At the time of the evaluation, only the game-based entry point was activated, and one of the 22 planned mini-games was available for testing. At the end of each session, participants received simulated professional development recommendations. At the time of the evaluation, these recommendations were not generated by a comprehensive algorithm. Instead, they served as a conceptual placeholder that allowed participants to reflect on the intended recommendation logic of the platform and to provide feedback on the overall concept despite the prototype's incomplete implementation.

Participants were instructed to navigate and interact with the system independently. They were asked to complete the mini-game, explore the recommendation output, and comment on their experience while using the system. During task completion, they were encouraged to verbalise their thoughts in accordance with the think-aloud method in order to capture immediate reactions, perceptions, and emerging difficulties during system use. The study followed a low-intervention approach, with test moderation kept to a minimum to preserve natural interaction. After the interaction phase, a short semi-structured interview based on an interview guide was conducted to capture participants' overall impressions of the platform.

3.2 Data Collection and Analysis

A total of nine teachers from a privately operated vocational school involved in the ELMeKS.digital project participated in the study. Participants represented a range of subject areas and reported differing levels of prior experience with computer games and digital technologies during the testing session. A detailed assessment of participants' digital competence and technology usage behaviour was beyond the scope of this exploratory usability study, whose primary aim was to identify barriers arising during interaction with the prototype. Such barriers may occur across different levels of prior digital experience. Participation was voluntary, and informed consent was obtained from all participants. The empirical data collection was conducted on three separate testing days within a period of eight days.

All sessions were recorded using screen capture software, including audio recordings of participants' verbal protocols. The resulting data were transcribed and anonymised. Two recordings proved unusable and were therefore excluded from the analysis. The remaining seven think-aloud transcripts, together with the interview data, were analysed using qualitative content analysis with a deductive coding approach supported by MAXQDA software. The deductive coding framework was informed by the study's analytical focus on motivational effects,

competence reflection, and usability challenges. The analysis focused on identifying patterns related to perceived usability, user experience, and potential barriers encountered during interaction with the prototype.

4. Findings

Analysis of the think-aloud transcripts suggests that the value of the game-based approach lies primarily in its potential to foster motivation and encourage users to reflect on their own competences and learning needs during professional development search. At the same time, the data revealed several usability challenges, particularly with regard to navigation and interaction, which at times hindered a smooth user experience.

4.1 Motivational Effects

The findings suggest that the game-based approach can have motivating effects when participants perceive the overall concept and its playful elements positively. Several participants regarded the approach as an appealing alternative to more conventional search models, which are typically characterised by straightforward keyword-based searches. In particular, the narrative framing of the missions was viewed positively. The introduction to the storyline, for example arriving at the school by bus, contributed to a more immersive experience for many participants, while interaction with non-playable characters added to the overall character of the game environment. As one participant noted, “I really like that you actually arrive by a means of transport and immediately receive a task. The introduction is really well designed.” The mini-game itself was also generally well understood in terms of its content and objectives. Motivational effects were especially evident among participants who perceived the mission closely connected to their everyday professional practice. The findings suggest that the motivational potential of the game-based design is strongest when it is closely linked to job-related content and when users are willing to engage with the format as an alternative to conventional search approaches. However, when participants were less receptive to the game-based format or found the mini-game itself unappealing, its motivational potential was limited. In these cases, the playful elements did not increase motivation to engage with the website or the professional development search process, but instead led to frustration and rejection. For some participants, the mini-game was too similar to the tasks they already perform in everyday school life. As a result, the game mechanics were perceived as offering too little novelty or excitement, which reduced their motivational impact.

Further motivational effects were associated with the visual design of the platform and the game environment. Several participants perceived the platform as more appealing than conventional professional development portals and described the interface as inviting and well structured. At the same time, certain design-related aspects of the game-based approach had a negative influence on motivation. In some cases, participants felt discouraged from continuing with the game because the interaction and navigation were perceived as difficult or insufficiently guided. A lack of guidance within the game environment sometimes meant that players did not know what to do next. As one participant described, “At first, I didn't know where I was supposed to go, so I just started walking around.” This reduced the sense of flow and weakened the motivational effects that the playful design was intended to create. In addition, textual elements within the interface were described as frustrating or distracting by some participants. Both excessively long and insufficiently informative text passages were perceived negatively because they interrupted the interaction with the game. Several participants also perceived the recommendation system and the presentation of training opportunities as motivating. The ability to organise and prioritise recommendations using features such as “Favourites” was described as useful, as it enabled a more personalised and manageable search process. The option to access saved results via a session ID without creating an account was also received very positively.

4.2 Competence Reflection

Beyond its motivational potential, the findings also suggest that the game-based approach encouraged participants to reflect on their own competences and professional development needs. The playful design of the missions appeared to provide a low-threshold and less confrontational environment in which participants could engage more openly with their areas for improvement. Rather than assessing their abilities through a formal evaluation setting, participants reflected on them while interacting with the game tasks. Furthermore, the mini-game supported competence reflection by establishing clear links between task performance and potential professional development needs. The automated feedback provided by the system stimulated reflection on participants' own competences, as they compared their self-assessment with the evaluation generated by the platform. As one participant noted: “In the end, I was a bit surprised by the result because I actually liked the presentation. Apparently, the computer didn't.” This illustrates how the automated feedback prompted participants to reflect on their own competence assessment. At the same time, difficulties in using

the platform led some participants to question their own digital skills, particularly with regard to navigation, interaction, and orientation within the game environment, as well as their familiarity with game-based interaction patterns.

4.3 Usability Challenges

The usability challenges extended beyond the perceived lack of competence described above and concerned several aspects of navigation and interface design.

The most significant usability challenge concerned the platform's navigation mechanics. Both within the game environment and inside the mini-game itself, participants had to navigate using a player character while simultaneously combining keyboard commands, particularly the arrow keys, with mouse interactions. For almost all participants, this initially led to navigation difficulties, misclicks, and uncertainty regarding movement and interaction within the game environment. Although these difficulties diminished over the course of the session as participants gradually understood how the controls worked, the initial interaction often caused frustration.

General orientation on the platform also proved challenging for some participants. The unconventional structure of the user interface, the non-linear navigation, and the absence of a conventional "back" arrow made it difficult for users to find their way around. Instead, the platform required participants to orient themselves independently within both the web portal and the game environment. As a result, neither the platform as a whole nor its game-based components were perceived as particularly intuitive by all participants.

Additional usability issues arose from design-related ambiguities within the prototype. Participants were not always able to clearly identify which interface elements were clickable, which created uncertainty during navigation. Certain controls were not designed clearly enough, while others were expected in specific places but were not provided. Moreover, the function and meaning of some icons and buttons were difficult for participants to determine. At the same time, some of these issues can be attributed to the prototype stage of development at the time of testing, when not all interaction patterns and visual indicators had been fully implemented.

Integrated features intended to support orientation and provide guidance were generally well received. Participants noted that instructional and explanatory texts helped them navigate the website and the game environment more effectively and made it easier to understand the tasks. Visual guidance elements, such as arrows and progress indicators, were also perceived as helpful while completing the task. Several participants expressed the need for additional guidance of this kind, suggesting that such supportive design elements play an important role in improving overall usability.

5. Discussion

The findings suggest a link between usability and motivation in the playful exploration of digital teaching competencies. These dimensions appear to influence one another throughout the interaction process. Motivational effects did not emerge from playful elements alone, but rather when participants perceived the platform as both user-friendly and relevant to their professional practice. In this sense, usability can be understood as a prerequisite for motivated engagement in game-based systems designed to support the search for professional development opportunities. This is particularly relevant for adult learners and vocational school teachers, who approach game-based interaction with varying degrees of openness and prior experience. While playful and narrative elements can promote engagement and lower barriers to participation, they also introduce additional complexity, which may negatively affect the intended learning experience. The findings therefore suggest that game-based approaches require a careful balance between playful interaction and intuitive design. This interrelationship can also be understood through Csikszentmihalyi's (1990) concept of flow, which assumes an optimal balance between perceived challenge and individual competence. In the present study, this balance was disrupted when participants encountered ambiguities in the navigation and interaction. As a result, cognitive resources shifted from reflective engagement with the task toward solving interface-related problems.

The study further indicates that competence reflection is closely linked to motivational engagement with the platform. Reflective processes appeared to be particularly pronounced when participants were able to immerse themselves in the game-based environment and focus on the professional situations represented in the missions. In this context, the playful nature of the interaction can shift the focus away from an exam-like setting toward a situated professional scenario. Game-based environments can therefore create conditions that encourage users to engage with their own professional development needs in a less intimidating and more practice-oriented way. At the same time, the findings suggest that reflective engagement can be disrupted when

usability barriers dominate the interaction experience. If users must focus primarily on understanding navigation and interface logic, attention may shift away from professional reflection towards solving usability-related problems. Consequently, competence reflection in game-based professional development environments cannot be considered independently of usability and motivational factors. Rather, it appears to depend on whether the interaction is experienced as engaging rather than frustrating.

The game-based environment created a situational context in which participants could explore aspects of their professional competence through practice-oriented tasks. This aligns with theoretical perspectives that conceptualise professional competence as a multidimensional construct comprising reflexive, motivational, and situational dimensions (Weinert, 2001; Baumert & Kunter, 2013). The findings also suggest that motivational engagement was shaped less by isolated reward-like elements than by the broader narrative and situational framing of the game. In this respect, the results support assumptions from game-based learning research that meaningful task design and embedded learning goals are central to engagement and learning-related reflection. However, the usability problems observed in the study often disrupted this intended experience before deeper engagement could develop. This suggests that the cognitive load caused by interface complexity may compete with the resources required for reflective and motivational engagement. Future research should examine whether repeated use of game-based environments leads to more lasting changes in motivation for professional development and to increased participation in professional development opportunities. Since this study followed an exploratory evaluation approach, the results should be understood primarily as a basis for the iterative further development of the system. Conclusions regarding effectiveness cannot be drawn within this framework and were not the intended focus. In particular, longitudinal designs could help to clarify whether the motivational and reflective effects identified in this study translate into longer-term changes in professional learning behaviour.

6. Conclusion

This study examined the potential of a game-based approach for supporting professional development search among vocational school teachers. The results indicate that the game-based approach developed in the ELMeKS.digital project can support motivation and competence-oriented reflection. However, these effects depend on sufficient usability within the digital environment. The findings suggest that interactive scenarios and mission-based tasks can provide a more engaging and less intimidating approach to professional development discovery than traditional keyword-based interfaces. Embedding professional scenarios into gameplay appeared to encourage users to reflect on their own competences in a practice-oriented manner. However, engagement was reduced by navigation difficulties and insufficient interaction aids. The study illustrates that motivational and reflective effects in game-based learning environments arise from the interplay of usability and perceived professional relevance. When these components are aligned, game-based environments can support low-threshold access to professional development opportunities.

However, the study is limited by the fact that the system was evaluated at the prototype stage. At the time of the evaluation, only one mini-game was available, and the recommendation system was not yet fully functional. The findings should therefore be interpreted as exploratory and specific to the tested version of the system. Future studies could additionally examine how technological background influences user perceptions and evaluate the fully implemented system with a larger and more diverse sample to investigate its long-term effects on professional development behaviour.

Ethics Declaration: No formal ethical approval was required for the study, as no sensitive personal data was collected and participation was voluntary and anonymous. All participants were informed of the purpose of the study and consented to the use of their data for research purposes.

AI Declaration: AI tools were used to edit and translate the manuscript. The authors have reviewed and revised all the generated content and accept full responsibility for the final version of the article.

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