



Exploring the Impact of a Digital Escape Room in Moodle on Students' Motivation

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Abstract

Knowledge Management is a core subject in the bachelor's program in Information Systems at the Nuremberg Institute of Technology. To enhance learning, a digital escape room was developed and implemented on the Moodle e-learning platform. The project addressed three research questions: Is Moodle a recommendable platform to implement a digital escape room? Are digital escape rooms a reasonable concept to teach knowledge? Are students motivated to gain knowledge with an escape room? A prototype was initially evaluated, revealing improved learning outcomes, particularly among students who enjoy quizzes. However, the quiz-based format of Moodle proved unsuitable for certain topics, and the platform's limited capabilities for game development posed challenges. The original escape room's duration of two to three hours was considered excessive by students, leading to a revised version with a more manageable length of 90 minutes. Usability testing, employing the think-aloud method, was conducted to refine the design before re-release. A subsequent pilot revealed that 70% of students valued the escape room for knowledge acquisition. While many enjoyed the puzzles, some preferred traditional exam preparation. These findings suggest that digital escape rooms hold promise as innovative pedagogical tools. However, their success depends on careful adaptation to course content and student needs, making them a potential complement to traditional learning methods. The overarching goal of this project is to evaluate the efficacy of digital escape rooms as innovative pedagogical tools and to explore their potential in reshaping conventional learning environments.

Keywords: gamification; learn management system; Moodle; motivation; online games

1. Motivation

The incorporation of educational learning games into the curriculum has been shown to significantly reinforce knowledge acquisition, enhance problem-solving abilities, and foster collaboration and communication skills among students (Dicheva et al., 2015, p. 75). A longitudinal analysis conducted by Putz et al. (2020) further substantiates these findings, demonstrating that gamification positively impacts students' knowledge retention over time.

In their exploration of innovative teaching methodologies, López-Belmonte, Segura-Robles, Fuentes-Cabrera, and Parra-González (2020) highlight the use of escape rooms as a compelling component within the broader frameworks of gamification, flipped learning, and

problem-based learning. These escape rooms are designed to engage students through enigmas and clues related to educational content, thereby creating an interactive and immersive learning experience (López-Belmonte et al., 2020, p. 1).

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Given the growing body of evidence supporting the efficacy of gamification and innovative pedagogical approaches, this paper aims to delve deeper into the mechanisms through which educational games and escape rooms enhance learning outcomes. By examining the practical applications and theoretical underpinnings of these methods, we seek to contribute to the ongoing discourse on how best to integrate gamification into educational settings to maximize student engagement and achievement.

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This project is driven by three pivotal research questions aimed at evaluating the feasibility and effectiveness of using digital escape rooms as educational tools within the Moodle platform:

1. Is Moodle a recommendable platform to implement a digital escape room?

This question explores the suitability of Moodle, a widely used learning management system, for creating and deploying digital escape rooms. The investigation focuses on Moodle's technical capabilities, user interface, integration options, and overall effectiveness in supporting the interactive and immersive nature of escape rooms.

2. Are digital escape rooms a reasonable concept to teach knowledge?

This question examines the pedagogical viability of digital escape rooms as a method for knowledge transmission. It evaluates how well these escape rooms can convey educational content, the depth and retention of knowledge acquired through this medium and their effectiveness compared to traditional teaching methods.

3. Are students motivated to gain knowledge with an escape room?

This question assesses the motivational impact of digital escape rooms on students. It investigates whether the gamified and engaging format of escape rooms enhances students' enthusiasm for learning, promotes active participation, and encourages a deeper commitment to acquiring and applying new knowledge.

By addressing these questions, the project aims to provide a comprehensive evaluation of digital escape rooms as innovative educational tools and to determine their potential to transform traditional learning environments.

ning environments.

The next section of this article provides an overview of the concepts of the Moodle e-learning platform and digital escape rooms. Subsequently, the methodology is outlined, followed by an evaluation of the project based on feedback from test groups and concluding with a summary of findings and an outlook for future research.

2. Background

2.1 Moodle / H5P

This section introduces the Moodle learning platform as an online educational tool in higher education, recognized for its flexibility, open-source design and capacity to support diverse teaching strategies. The integration of gamification tools, such as H5P, enhances its utility by enabling the creation of interactive content, like quizzes and videos, which improve student engagement, satisfaction, and learning outcomes, particularly in STEM disciplines.

Moodle “is an online educational platform that provides custom learning environments for students” (TechTerms, 2022). Moodle (Modular Object-Oriented Dynamic Learning Environment) is used to configure and conduct internet-based courses (Nash, 2022). The acceptance of Moodle as a learning management system (LMS) in higher education is influenced by several factors, impacting both faculty and students. Research shows that Moodle is widely embraced due to its flexibility, open-source nature and capacity to support diverse pedagogical strategies (García-Murillo et al., 2023). For students, Moodle has demonstrated positive effects on engagement, satisfaction and learning outcomes. Studies reveal that students value Moodle’s role in organizing coursework and enabling asynchronous learning. However, differences in acceptance can be attributed to factors like prior experience with e-learning tools and the perceived relevance of Moodle to their specific fields of study. Gamage, Ayres, and Behrend (2022) carried out a systematic review to examine emerging trends in the use of Moodle as a platform for teaching and learning. Their review indicates that Moodle is predominantly used within STEM disciplines in higher education. They highlight that Moodle effectively enhances students' performance, satisfaction and engagement. Additionally, Moodle is increasingly utilized as a platform for adaptive and collaborative learning, as well as for improving online assessments.

Gamification elements in Moodle include quizzes and interactive content created using H5P (HTML5 Package). H5P is free, open-source software that allows educators to create, share, and reuse interactive HTML5 content seamlessly. It offers a wide array of pre-existing content types that can be integrated into educational materials, such as interactive videos, presentations with embedded quizzes and memory games. Rahmi et al. (2024) aimed to analyze, develop, and evaluate the use of H5P for content delivery in a blended learning environment. Their study focused on the alignment of the H5P content with lecture topics, the integration of activities designed to achieve learning outcomes within a rotation-based blended learning model and students' perceptions of the H5P content after its implementation. Their results indicated that the use of H5P as a supporting component increases student knowledge, skill and satisfaction.

These gamified elements can be embedded into digital learning environments to offer a dynamic and engaging approach to education. For example, quizzes can be used to assess students' understanding of the material in real-time, providing immediate feedback that aids in learning reinforcement. Interactive videos and presentations with embedded quizzes not only make learning more engaging, but also ensure active participation from students, which is crucial for knowledge retention.

H5P’s versatility and its wide dissipation make it an attractive tool for educators looking to incorporate gamification into their teaching strategies. By utilizing H5P, educators can create a variety of interactive content that serves to support different learning styles and preferences, ultimately fostering a more interactive and immersive learning experience.

2.2 Digital escape rooms

This section explores the evolution and application of escape rooms in education, emphasizing their digital adaptation for enhanced engagement, motivation and active learning. It highlights the growing implementation of digital escape rooms in higher education and STEM, with studies examining their learning outcomes, such as teamwork and communication skills, while addressing challenges like platform selection and the need for empirical validation. Research also outlines frameworks for designing effective digital escape rooms, focusing on elements like storylines, puzzles, and feedback mechanisms to support diverse pedagogical goals.

First, the concept of escape rooms is explained, focusing on their transformation from physical games into digital formats. According to the Cambridge Dictionary (2021), a traditional escape room is a game in which participants are "locked into a room and have to find a way to escape by finding clues [...] in it and solving puzzles." Building on this concept, Grande-de-Prado, García-Martín, Baelo, and Abella-García (2021) describe a digital escape room as an online game, in which players complete tasks digitally, progressing through a storyline to achieve a specific objective. Nowadays, escape rooms come in various forms: physical escape rooms in dedicated locations, city escape games, board games, and digital escape rooms. In digital escape rooms, players engage with a narrative and solve a series of digital tasks to reach a predefined goal.

In traditional, real-world escape rooms, players gradually uncover more details about the initial storyline as the game progresses. Typically, teams work collaboratively to solve puzzles. Upon entering the room, participants analyze the available inventory, using the information and clues gathered to explore the space and locate puzzles that unlock new areas. Once a puzzle is discovered, it must be successfully solved. Digital escape games adhere to the same principles and can be designed for both individual players and teams.

Subsequently, the implementation possibilities are briefly discussed. Escape room developers can design the game path either in a linear format, where each puzzle must be solved in a predetermined order, or dynamically, allowing for more flexibility in the sequence of tasks based on player choices or actions. Nicholson (2015) described possibilities to organize the puzzles: open structures, sequential structures, path-based structures and hybrid structures: In an open structure, players can solve multiple puzzles simultaneously, with all other puzzles needing to be completed before the final one. In a sequential structure, puzzles are presented one after another, with each solution unlocking the next, culminating in the meta-puzzle. The path-based structure involves multiple puzzle paths, where players follow different routes. A complex, hybrid structure can combine these basic structures, potentially taking forms such as a pyramid. (Veldkamp et al., 2020, p.2)

The following information demonstrates the growing importance of escape rooms, particularly in educational settings. Studies show that they are increasingly integrated into higher education and STEM disciplines to enhance engagement, learning outcomes and teamwork. Fotaris and Mastoras (2019, pp. 240–242) highlight the growing trend of incorporating escape rooms into educational contexts in their meta-study. While 72.1% of the studies examined fall within the field of higher education, only 14.7% focus on information and communication technologies. The subject of "Knowledge Management" is part of this area. However, only 10.6% of the studies address digital escape rooms.

Ang et al. (2020) transitioned a physical escape room to a digital format for a first-year chemistry course due to the COVID-19 pandemic, using Google Forms for implementation. Student feedback indicated that both types of escape rooms reinforced and motivated learning.

However, survey results also revealed a preference for the physical escape room, as students valued the real-world environment it provided.

Makri, Vlachopoulos, and Martina (2021) conducted a systematic literature review focusing on the use of digital educational escape rooms as innovative tools in teaching and learning. They found that digital escape rooms are implemented in various contexts and believe they are an effective way to enhance access to training, communication, and interaction. The majority of the publications originated from European countries, where designers appear to favor game-based learning activities in educational settings. The most common target group in the studies were higher education students, with a smaller representation of secondary and primary education students.

The following studies focus on the motivational outcomes of escape rooms for students. The meta study of Veldkamp et al. (2020) examined the learning outcomes of educational escape rooms. Their research included the extent to which the following goals were reached by educational escape rooms:

- to explore an active learning environment
- to increase students' motivation and/or engagement
- to foster learning and
- practicing or developing teamwork and communication skills. (Veldkamp et al. 2020, p. 8).

Lathwesen and Belova (2021) conducted a literature review focusing on escape rooms in Science, Technology, Engineering, and Mathematics (STEM) teaching and learning. They emphasize the need for more easily adaptable escape rooms and call for additional empirical evidence regarding their actual effects.

Sidekerskienė and Damaševičius (2023) aim to assess the impact of digital escape rooms on student engagement and learning outcomes in mathematics education. Their study seeks to offer insights into the effectiveness of this method in teaching mathematics while promoting active and experiential learning within the broader context of STEAM education. They propose a conceptual framework to explore the pedagogical value of digital escape rooms in STEM disciplines. The study details the design process, encompassing elements such as learning paths, scenarios, storylines, puzzles, challenges, and feedback mechanisms, and introduces the concept of escape room design patterns.

This non-exhaustive list highlights the diverse implementations of educational escape rooms across various fields, with higher education being one of them. Many of these escape rooms exist exclusively in digital form rather than in real-world settings. A key challenge in implementing a digital escape room is selecting an appropriate platform. The goal of this investigation is to develop a digital escape room using the widely used educational platform Moodle.

3. Methodology

3.1 Design of the Narrative

Escape rooms are characterized by the use of a fictive context to immerse participants in a narrative, where solving puzzles is integral to progressing through the storyline. In this digital escape room, a storyline was carefully crafted to engage students, aligning with both the subject matter and the intended learning outcomes. The narrative begins with an invitation to a job interview at a fictional company, introduced through a variety of media, including a

pamphlet, a company website, promotional videos and a job advertisement. These materials serve not only as context for the story but also provide embedded clues that guide participants toward solving subsequent puzzles. The storyline begins with the applicant entering the interview phase, but the narrative takes an unexpected turn when the applicant is left alone in an office. This plot twist marks the initiation of the escape room challenge, where participants are tasked with solving a series of puzzles to "escape" the building. Throughout the game, players navigate through a sequence of virtual rooms, each containing unique challenges and clues. As they solve puzzles in each room, they unlock new areas and move closer to reaching the exit. For example, Figure 1 presents a virtual office room containing a large desk, three armchairs and a neatly organized shelf. Within this room, players must explore their environment to find hidden clues that will aid their progress. The virtual room is designed as an immersive 360° image, enriched with various forms of media, including images, texts, and videos. These elements not only enhance the user experience but also provide additional hints, helping players solve puzzles while maintaining engagement with the storyline. Such a multifaceted approach fosters active learning, as players are required to engage both cognitively and interactively with the content, transferring theoretical knowledge to practical application.

Figure 1: A virtual room of the game



3.2 Evaluation Processes

The first version of the digital escape room was developed in 2020 and initially used in 2021 (Schuhbauer et al., 2022). Prior to its first use in the course, two small test groups, each consisting of about five people, evaluated the room. The first group's task was to test the technical functionality, quiz difficulty and correctness. Navigation within Moodle proved challenging for some users due to its limited features, requiring explicit instructions on how to navigate the course. While the quizzes were correct in terms of content and difficulty, the course duration was too long, and some quizzes were deemed too difficult. The user interfaces of some quizzes were also awkward due to Moodle's limitations. Based on feedback, the duration of certain puzzles was shortened, and additional clues were added.

The second test group consisted of students from the Knowledge Management course. Participation in the escape room was optional, and surprisingly, only a small group engaged. It was assumed that those who participated enjoyed solving puzzles. This group's task was to evaluate the time spent, their learning success and their motivation. Feedback from this group

was overwhelmingly positive. In 2022 and 2023, the digital escape room was integrated into the Knowledge Management course, with approximately 60 students using it each year. Some students noted that the escape room's duration (over two hours) was too long and that certain quizzes were difficult, requiring considerable time and effort to solve.

In 2024, this version was revised due to the weaknesses identified, particularly the duration and high complexity. The existing elements were thoroughly analyzed regarding their relevance to the storyline, complexity and the time required to solve the game. Some elements were removed, and the storyline was coherently adjusted. Other puzzles were shortened or simplified with additional solution hints. The revised version was initially tested with several participants using the think-aloud method, and adjustments were made as necessary. The think-aloud method is a qualitative research technique used to gain insights into the cognitive processes of participants as they perform a task (Eccles & Aarsal, 2017). This method involves participants verbalizing their thoughts, feelings, and reasoning while engaging in an activity (McDonald et al, 2012). The goal is to capture real-time data on how individuals approach and solve problems, providing researchers with a deeper understanding of their cognitive processes. In the context of testing the revised digital escape room, the think-aloud method was used to gather detailed feedback on participants' experiences. Participants were asked to continuously articulate their thoughts as they navigated through the escape room, explaining what they were thinking, why they were taking specific actions and how they were interpreting and solving puzzles. This process helped identify points of confusion, cognitive load and the decision-making strategies used by participants. By listening to the participants' thought processes, we were able to pinpoint specific areas where the escape room could be improved. This included identifying puzzles that were too complex or unclear, elements that did not contribute to the storyline and tasks that took longer than expected to solve. The real-time feedback provided by the think-aloud method was crucial for making targeted adjustments to enhance the overall user experience, thus ensuring that the final version of the escape room was more engaging and appropriately challenging for the intended audience.

The updated escape room was reintroduced into the classroom and evaluated. Out of approximately 60 participants, only 20 completed the evaluation, which is the topic of the following section. The limitations arising from the narrow sample size are discussed in Section 5. The evaluation was done in Moodle with the feedback mechanism, placed at the end of the escape room, to ease the access to the evaluation form.

4. Results of the Evaluation

A survey made up of 34 questions was conducted at the end of the digital escape room in Moodle. The survey aimed to gather detailed feedback on the participants' experiences and prior exposure to escape rooms in teaching and learning. To address questions regarding students' experiences and preferences related to an escape room, questions from standardized and validated questionnaires were integrated. The evaluation distinguished between intrinsic and extrinsic motivation, using primarily validated questionnaires based on the Self-Determination Theory (SDT) (Ryan & Deci 2000, 67–78). To measure the students' motivation, questions from the Intrinsic Motivation Inventory IMI were adopted (Ryan & Deci 2000, p. 68–78), (McAuley et al. 1989, p. 49-54). This questionnaire provides the opportunity to quantitatively measure different types of motivation and is modular. The dimensions or subscales include Interest/Pleasure, Perceived Competence, Effort, and Pressure/Tension. A benefit of this measurement tool is that excluding or including a subscale does not negatively affect the other dimensions. Additionally, individual redundant items can be removed or their wording adapted to the context. The selection of questions is based on

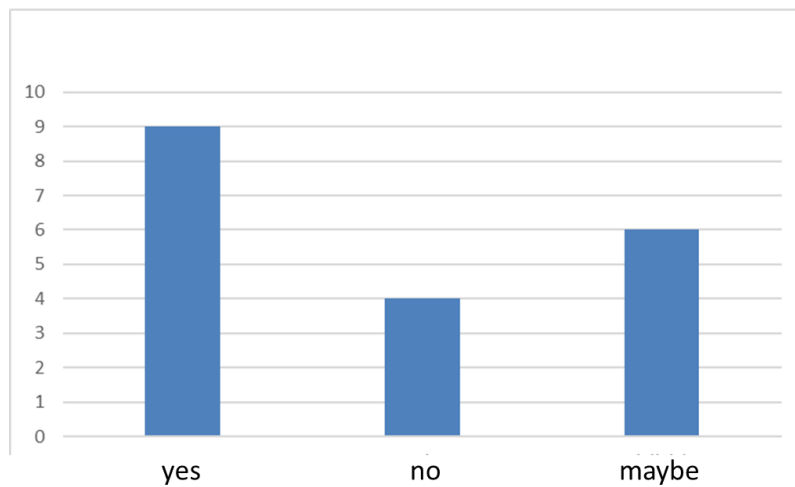
their validity, modularity, and adaptability. As a second reference questionnaire, the Situational-Motivation-Scale (SIMS) was used to assess the motivation of students in the context of the digital escape room. The SIMS, developed by Guay et al. (2000), is a validated instrument for measuring situational motivation and includes dimensions such as intrinsic motivation, identified regulation, external regulation, and amotivation. This scale was specifically developed to measure motivation in specific contexts, making it particularly suitable for analyzing motivation in a learning game environment. To evaluate knowledge acquisition, questions from the Student-Evaluation of Educational Quality (SEEQ) instrument were used. This tool provides a comprehensive framework for assessing teaching quality and learning (Marsh 1982, p. 77–92), (Daumiller et al. 2021). This questionnaire includes nine dimensions, such as learning gain, overall evaluation, teacher engagement, course structure and presentation, student activation, social climate, content breadth, performance assessment, and assignments. To evaluate the usability, modified questions from the Post-Study-System-Usability-Questionnaire (PSSUQ) and the Website-Evaluation-Questionnaire (WEQ) were used. The PSSUQ, developed by Lewis (1992), is used to measure the usability of systems, while the WEQ was specifically designed to assess the usability of websites (Elling et al., 2007). Integrating these questions allows for a precise assessment of the User Experience and User Interface in different contexts.

Below, we present the most interesting and meaningful survey results. The results revealed that while 70% of the students who completed the survey had previously played in a live escape room, only 30% had prior experience with digital escape rooms. This disparity highlights the novelty of the digital format for many participants. Most of the participants stated that the duration of the new version of the escape room was well suited.

Interesting is the fact that most of the participants stated that they would prefer to work more often with an educational escape room. The answers which refer to this fact are illustrated in Figure 2.

Figure 2: Preferences for educational escape room

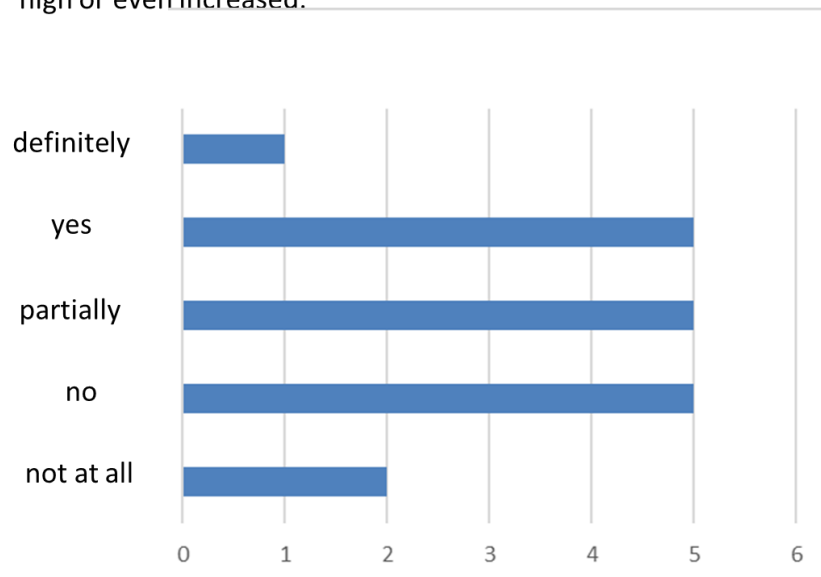
Would you like to work on an escape room with educational content more often?



The students were asked whether they remained motivated to continue working on the remaining tasks after completing approximately half of them. The responses varied considerably, as illustrated in Figure 3.

Figure 3: Motivation during the game

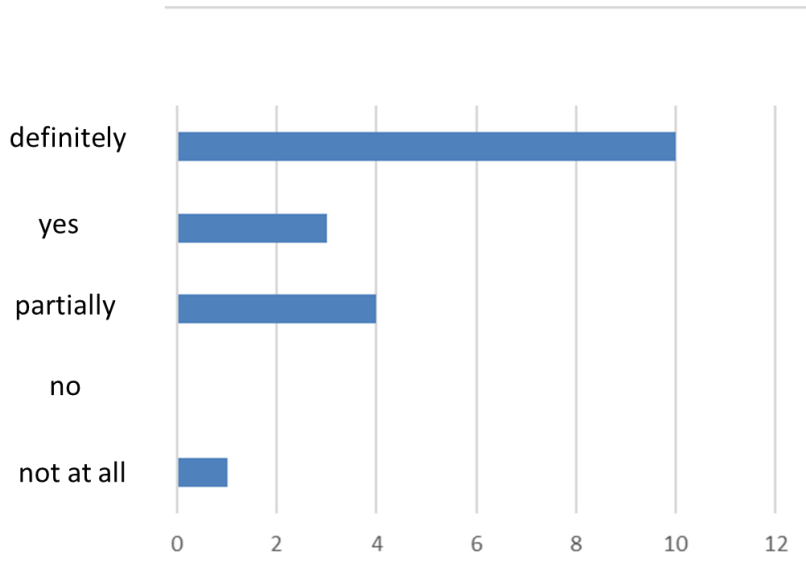
After completing part 3, the 'Mini Escape Room,' my interest and motivation to play the game until the end remained consistently high or even increased.



The students' responses were clear regarding the different digital presentations of the quizzes. They found the interactive elements favorable and expressed a desire for more interactive game elements in the future which is shown in Figure 4.

Figure 4: Preferences for interactive game elements

I would like to see more interactive game elements, such as 360° images and drag-and-drop tasks, instead of purely text-based tasks.



Also, of great interest was the response to the question of whether learners find an escape room useful for acquiring knowledge. 64% of the participants considered an escape room suitable for learning. Notably, the escape room tested did not contain any new knowledge content for the participants. Instead, it focused on applying and deepening knowledge already acquired previously.

5. Conclusion

Returning to the research questions of this project, the following answers were found:

The first question is, "Is Moodle a recommendable platform to implement a digital escape room?" Based on the experience of this project, it is possible to design a digital escape room in Moodle. However, since Moodle is primarily a learning platform and not designed for gaming, several limitations were encountered:

- High implementation effort: Workarounds were required to manage the dependencies between the puzzles.
- Long course duration: Users reported that the course took too long due to the extended loading times of some puzzles.
- Browser compatibility issues: Not all browsers supported all H5P elements, especially the virtual tour, which is a central element of the course, causing display problems.
- Limited dynamic elements: Moodle's dynamic features are constrained, reducing the scope for more complex implementations.
- Basic activity tracking: Effective tracking is crucial for an escape room, as users should only be able to progress to subsequent areas after solving quizzes. However, Moodle's tracking capabilities are limited, further restricting implementation possibilities.

Details about these findings can be found in (Schuhbauer et al., 2022).

Second question is: “Are digital escape rooms a reasonable concept to teach knowledge?” Students who participated in the escape room gained substantial knowledge about the subject of Knowledge Management. They were required to understand the material and apply theoretical concepts to the case study presented in the escape game. As a result, the escape room proved to be a successful teaching approach, a conclusion that was also supported by the learners in the survey.

The third question is: “Are students motivated to gain knowledge with an escape room?” Most of the participants stated that they would prefer to work more often with an educational escape room. Noteworthy is the wide variation in responses to the question of whether the students maintained their motivation throughout the game. Some students felt that the time needed to solve the puzzles was too long, particularly in comparison to the time required for regular learning activities. The results of a study by López-Pernas et al. (2022) show “that students' behavior differed significantly in their use of hints in the escape room and resulted in differences in their knowledge acquisition levels”. Their results agree with our findings.

The utilization of educational escape rooms represents a promising and innovative approach to enhancing learning experiences. The results of our study indicate that these interactive, game-based environments can engage students and facilitate the application of knowledge in a dynamic setting. Notwithstanding the disparate responses pertaining to motivation and the efficacy of assorted game components, the aggregate findings demonstrate a favorable response among participants. The incorporation of escape rooms into educational settings offers a distinctive opportunity to apply theoretical knowledge in tangible, problem-solving scenarios. This approach not only serves to reinforce existing learning but also introduces elements of enjoyment and challenge that can significantly enhance student engagement and motivation. However, in order to optimize their efficacy, it is essential to give due consideration to the design and complexity of the escape room tasks, in order to ensure that they align with the educational objectives and are appropriately challenging without causing frustration.

The limited sample size of 20 out of 60 participants in the evaluation significantly restricts the generalizability of the findings. Smaller sample sizes can lead to biased results, as they may not fully represent the wider population's characteristics or responses, thereby limiting the ability to draw broad conclusions (Mertens, 2023). In addition, results derived from a small sample may not be consistent with those from a larger, more diverse group, thus reducing the external validity of the study. Therefore, while the findings provide valuable insights, they should be viewed with caution until they can be replicated with a larger, more representative sample. Furthermore, the study concentrates on a specific subject area, and additional research is required to ascertain the applicability of the results to other disciplines.

6. Outlook

Further research is indeed crucial to explore the full potential of educational escape rooms, especially their impact on various learning outcomes, such as critical thinking, problem-solving and teamwork (Veldkamp et al., 2020). The adaptability of these tools across subjects remains an important area of study, as the effectiveness of escape rooms may vary depending on discipline-specific requirements (Lathwesen & Belova, 2021). Investigating their long-term effects on student retention and understanding is equally important, as previous studies have shown that while escape rooms can increase immediate engagement, their lasting impact on learning outcomes still requires validation (Makri et al., 2021).

Moreover, identifying the most effective platforms and technologies for digital escape rooms is essential for optimizing their integration in different educational contexts (Rahmi et

al., 2024). For instance, platforms like Moodle and H5P offer flexibility for creating engaging and interactive experiences, but their limitations must be understood to enhance their effectiveness (Gamage et al., 2022). Therefore, a deeper exploration into platform-specific features and tools, combined with a refined design approach, could further increase the efficacy and appeal of escape rooms in educational settings.

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In conclusion, while educational escape rooms represent a promising pedagogical tool, their successful implementation depends on continued research and development. By improving their design, content alignment and platform integration, educators can create more immersive and effective learning environments that support active learning, collaboration and long-term knowledge retention.

The issue of restrictive answer options in quizzes, particularly in open-ended questions, highlights one of Moodle's significant limitations—its inability to recognize and evaluate responses that differ slightly from pre-programmed correct answers. This limitation, often due to the rigid structure of Moodle's answer recognition system, can result in valid responses being marked as incorrect simply because of minor spelling errors or the use of synonyms (Gamage et al., 2022). Such constraints can frustrate students and hinder their ability to demonstrate their knowledge in a more natural, flexible manner, ultimately reducing the platform's effectiveness as an assessment tool. The potential integration of artificial intelligence (AI) to evaluate answers more dynamically could address these issues by enabling more nuanced assessments. AI could process a wider range of responses, considering context, synonyms and even common typographical errors, thus providing a more accurate evaluation of students' understanding (Rahmi et al., 2024). However, this shift requires careful consideration of ethical standards, particularly in the context of higher education. The EU AI Act sets out key guidelines for the responsible deployment of AI, emphasizing transparency, accountability, and fairness in its use. Ensuring that AI-driven evaluations are aligned with these ethical principles will be crucial to prevent bias and ensure that assessments remain fair and reliable. Once an AI system is selected that complies with these standards, it will need to undergo rigorous training to adapt to the specific needs of educational environments. Its performance must be continuously evaluated to ensure accuracy and fairness in assessments, with particular attention paid to ensure that the AI does not inadvertently penalize students for minor mistakes or nuances in language use. By refining AI systems for educational use, future quiz-based assessments in Moodle can become more flexible and effective, ultimately improving the learning experience by offering a more accurate reflection of students' knowledge and skills.

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