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AI-proof Active Assessment and Future Skills Training with NoCode-Edu Escape Rooms

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Abstract

This study explores the implementation of NoCode-Educational Escape Rooms (EERs) as a robust assessment format in higher education, particularly in the context of artificial intelligence (AI). EERs, integrated within challenge-based learning frameworks, foster both subject-specific and transversal competencies. The study highlights the dual role of EERs in enhancing knowledge acquisition and future skills development, despite the presence of AI tools. Through practical engagement in creating EERs, students demonstrated significant improvements in subject-specific knowledge, critical thinking, and AI literacy. The necessity of independent content creation, beyond AI-generated assistance, emphasizes the importance of autonomous problem-solving. Moreover, the collaborative nature of EER development strengthened project management and teamwork skills. Overall, the findings suggest that EERs effectively prepare students for an AI-driven future by balancing AI utilization with the cultivation of essential cognitive skills.

Keywords: *AI-proofAssessment; EducationalEscapeRoom; CBL; NoCodeEscapeGame FutureSkillsTraining.*

1. Introduction

Higher education should move beyond merely transmitting knowledge and traditional skills, prioritizing instead the development of future skills (Ehlers, 2020). Learning processes must be more individualized and tailored to student needs (Kopp & Mandl, 2011; Veldkamp et al., 2020). Student agency and thus the experience of self-efficacy are key to academic success (Blaschke, 2017). In this context, challenge-based learning is recognized as an effective approach for fostering competency (Gallagher & Savage, 2020; Membrillo-Hernández et al., 2023).

However, students might rely too heavily on chatbots to complete tasks, thus risking de-skilling. This calls for assessment formats that are resistant to AI assistance yet promote AI literacy and future skills (Deng et al, 2024).

As both "learning by doing" and game-based learning scenarios support competency development (Hagedorn & Meinel, 2022; Schutz & Schwarz, 2022), NoCode-Educational Escape Room (NoCode-EER) present a promising for learning and assessment.

This experimental study shows that designing EERs within a challenge-based framework enhances subject-specific competencies and future skills, including AI literacy. Despite AI tool usage, the reflective process required to create an EER supports its use as an alternative assessment format.

2. Theoretical Foundation

Given the existence of slightly differing definitions, this section outlines the conceptual understanding of Educational Escape Room, NoCode-Edu Esacape Room and Challenge-based learning, which form the basis of the subsequent analysis.

2.1. The Use of EERs in Higher Education

Educational Escape Rooms combine game-based elements with didactic goals, requiring players to acquire and apply knowledge to progress – whether escaping a room or unlocking a new level (Buchner, 2022). Interactive mechanics foster self-directed learning, enabling exploration, problem-solving and competence devvelopment (Hoblitz, 2015). Furthermore, perspective-taking within these games promotes critical thinking (Bilbao et al., 2019), making EERs motivating and accessible learning formats.

NoCode Educational Escape Rooms (NoCode-EERs) are a subtype of EERs that require no programming skills and are free to create. They serve dual purposes: engaging content delivery (Wiemker et al., 2015) and formative assessment though tasks that hinge on correctly applying knowledge (Le & Weber, 2011). Integrated feedback and reward systems support active learning (Solomovich, 2020), and although extrinsic motivation incentives are debated (Hagedorn & Meinel, 2022), learner autonomy boosts intrinsic motivation (Krapp, 1999). Positive emotions such as ambition and curiosity enhance content retention (Marr, 2010), making EERs effective for asynchronous belnded learning. They can also serve as memory palaces, with content strategically distributed across different rooms to facilitate knowledge organization and retrieval (Huttner et al., 2018).

The dual function of EERs – as learning and assessing tools – makes NoCode-EERs especially valuable when created by students. Designing EERs supports deep engagement, peer learning, and competency development within a challenge-based framework.

2.2. Challenge-based Learning in Higher Education

Challenge-Based Learning (CBL) involves collaboratively solving real-world problems based on relevant scenarios (Membrillo-Hernández et al., 2023). It promotes core skills such as teamwork and time management, and interdisciplinary competencies like critical thinking and problem-solving. Depending on the task, students acquire subject-specific competencies independently (Lara-Prieto et al., 2019), preparing them for future careers. Combining CBL with the "learning by teaching" approach enables students to process and communicate complex content effectively (Schuhladen, 2020), benefitting both education and STEM fields (Čujdíková & Vanikúš, 2023). This integration can be implemented with minimal organizational effort.

Though CBL fosters AI competencies, overreliance on AI tools may hinder subject-specific learning. However, this study further highlights that creating NoCode-EERs based on seminar topics encouraged the development and assessment of subject-specific learning, interdisciplinary, and AI-related competencies whilst resisting deception by undisclosed AI assistance.

3. Participants and Methodology

In the seminars "Pedagogical Aspects of Digital Learning Environments" (conducted in the winter semesters of 2022 with 10 students, 2023 with 8 students, and 2024 with 9 students) and "Fields of Action in Vocational Education" (offered in the summer semesters of 2023 with 37 students and 2024 with 28 students). Both Bachelor's and Master's students were free to enroll in the courses depending on their curriculum and their preferences, resulting in a heterogeneous group with different levels of prior knowledge. Consequently, a flexible seminar design was necessary. Challenge-based learning proved to be an approach to adapt to these different learning needs. Therefore, all student groups worked on interactive information units – mostly EERs on a specific seminar topic.

3.1. Seminar Structure

The seminar structure evolved over time to incorporate emerging technologies and pedagogical strategies. In winter semester of 2022, the seminar curriculum introduced the students to general media didactics, digital learning materials and their advantages and motivational theory, accompanied by practical sessions on creating interactive content using H5P. In subsequent semesters, the seminar curriculum was expanded to include AI exploration with a focus on prompt design and AI's role in content creation.

The summer semesters introduced students to various vocational education fields and the impact of AI on learning and working, further supplemented by exercises in using generative AI for research and content creation.

At the beginning of each seminar, fundamental content was introduced during three to five weeks. Starting in the summer semester of 2023, targeted exercises on AI usage were incorporated – such as Socratic dialogues, self-tests, or reflection tasks. By the end of this input phase, the students revised some example projects and received a training in H5P for interactive content creation. Moreover, they had a brief introduction to Kanban and MS Teams for collaboration.

3.2. Tasks and Creation Process

After the theoretical phase, students (in groups of three to four) were then given eight weeks to collaboratively deepen their understanding of a selected seminar topic, e. g. “industry 4.0”. In the following, they were to develop digital interactive learning materials for the other groups, such as EERs, e-books or scrollytelling projects. These projects were selected via a booking pool. The students received project outlines that detailed key topic points.

The creation process required them to develop a narrative structure with the thematically relevant content, including tasks and puzzles that needed to be solved within the EER to ensure progression. Throughout this challenge phase, students worked in groups. They were free to choose to come to the seminar room to ask, present, and get feedback or do their groupwork via Teams – or both.

3.3. The Use of AI in the Seminar

Beginning in the summer semester of 2023, the integration of AI became a core component of the seminars. Students engaged in hands-on exercises in prompt design and explored specific use cases, such as summarization or Socratic dialogues. Later iterations introduced analysis, targeted content alignment or HTML code creation, reflecting the advancing capabilities of various tools, e.g. Copilot in comparison to ChatGPT.

3.4. Assessment and Evaluation

Assessment strategies included initial and final surveys to evaluate AI usage, perceived carreer relevance, and self-rated AI competencies on a 0-10 scale. At the beginning of the semester, the students rated their skills at 3.2 and by the end 7.3 on average. Throughout the semester, there were One Minute Papers to further document their competency growth. Upon completion of the project phase, the seminar content was re-evaluated by dialogical assessments.

A significant number of students (a total of 46) was re-evaluated after 6-12 months. In this follow-up study, students provided another self- assessment of their learning progress. Problem-centered interviews (Witzel, 2000) were also conducted to evaluate the retention of subject-specific knowledge and the consolidation of acquired competencies.

4. Results and Findings

On the basis of the interviews and enquiries above-mentioned, as well as observations during the seminar, the following competencies and skill got developed – due to or despite of the usage of generative AI.

4.1. Subject-specific Competence

At the beginning of the experiment, subject-specific competencies related to the seminar topics were expectedly low, given the heterogeneity of the participants. However, by the end of the semester, all participants rated their subject-specific competence in the seminar topic as high. In comparison to traditional seminar formats, such as oral presentations, they perceived a significant advantage in independently developing digital products.

Interviews conducted several months after the seminar confirmed that students' self-assessments corresponded to reality: The skills and competencies acquired closely aligned with the assessments made during the semester, demonstrating the sustainable impact of the EER creation process. Notably, the competencies acquired by students who had created an Educational Escape Room (EER) were more consolidated and transferable than those who had chosen other digital products as their challenge. This knowledge acquisition can be attributed to the development of tasks and model solutions, which required a deep engagement with the content, critical evaluation, and alignment with the learning objectives of the escape room. Since generative AI tools were useful for formulation but not fully sufficient for content development, students had to create a significant portion of the content independently.

Additionally, students found engaging with other groups' EERs particularly effective. The gamified approach increased motivation and significantly extended net learning time, as many students spent more than the designated 90 minutes per week interacting with EERs. Moreover, competencies gained through role-playing and case studies within the EERs were perceived as transferable to other scenarios within the same subject domain.

4.2. AI Competence

At the beginning of the semester, survey results indicated that students primarily used generative AI for entertainment and initial topic exploration. In the summer semester of 2023, none of the students had productive experience with generative AI. By the winter semester of 2023, more students were using AI for specific purposes, although with largely unsatisfactory results. By the summer semester of 2024, all students had used generative AI productively before the seminar, although satisfaction with AI-generated results varied significantly depending on the tool. The use of ChatGPT and Copilot was frequently deemed inadequate in terms of output quality and workflow efficiency, whereas specialized tools like Elicit were considered beneficial. Similar findings emerged in the winter semester of 2024.

Over the course of all semesters, the use of generative AI tools led to a substantial increase in AI competence. Students learned how to leverage AI productively, particularly for brainstorming and drafting content for their digital products. AI tools were used primarily for storyline development, content structuring, and audience-appropriate wording. With increasing experience, students refined their prompts, leading to higher-quality results.

Most EER groups incorporated case studies into their storylines and experimented with various role assignments for AI, deepening their understanding of goal-oriented and effective prompting. One group reported using a chatbot for decision-making when disagreements arose within the team.

4.3. Transversal Competences and Core Skills

At the beginning of the seminar, students rated their transversal skills, like self- and time-management, as low. Their self-assessments of problem-solving, team organization, and critical thinking varied but were generally on the lower end. By the end of the semester, survey results indicated that students perceived significant improvements in all these competencies.

Follow-up interviews further highlighted notable developments in problem-solving, critical thinking, and team organization. Particularly among the groups that had created an EER, it became evident that the complexity of the production process limited the possibility of excessive task division. Consequently, the experience improved students' ability to manage group dynamics and time effectively. Collaborative work on NoCode-EERs enhanced transversal competencies such as teamwork and problem-solving, with the escape room format particularly reinforcing these skills.

5. Conclusion

The integration of Educational Escape Rooms (EERs) in university seminars has proven to be an effective didactic method for fostering both subject-specific and transversal competencies, as well as a relevant assessment format in the age of artificial intelligence. The findings, listed above, indicate that independently creating digital products, particularly EERs, significantly enhances students' subject-specific knowledge. This is primarily due to the intensive engagement with content, the need for critical evaluation, and alignment with learning objectives. The challenge of designing tasks and puzzles led to a deeper understanding and better consolidation of knowledge, which was also perceived as transferable to other thematic contexts.

The examination of AI competence revealed a significant learning curve in handling generative AI tools. While AI was initially used primarily for information retrieval, students gradually developed a more productive approach. They learned to craft precise prompts and strategically

employ AI tools to support content creation and structural organization. However, the study also demonstrated that relying solely on AI was insufficient to meet the requirements of EER development, necessitating independent thinking and problem-solving.

Furthermore, a considerable increase in transversal competencies, particularly in self-management, problem-solving, and team organization, was observed. The collaborative nature of NoCode-EER development enhanced students' ability to work effectively in teams and navigate group dynamics. The complexity of the task required coordinated collaboration, leading to improved teamwork and time management skills.

Overall, the study's findings suggest that incorporating EERs into higher education not only deepens subject knowledge but also supports the development of future skills. These competencies are particularly relevant in today's AI-driven world, as they enable students to leverage AI's advantages while simultaneously strengthening their own cognitive and problem-solving abilities.

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