

Escape Room Challenges to Foster Engagement and Skills in Computer Science

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Abstract: This study presents the design, implementation, and evaluation of a gamified formative assessment in an undergraduate Computer Science course through a Harry Potter-themed escape room. Framed within the Mechanics-Dynamics-Aesthetics (MDA) framework, the activity integrated six sequential missions that blended technical skills with narrative immersion. These missions were strategically crafted to assess and promote communication, collaboration, computational thinking, and technical skills in areas such as web development, database management, and debugging in Unity. Each mission aligned with specific learning outcomes and was guided by a hypothesis exploring its impact on student engagement and skill development. A custom Unity interface delivered narrative cues, tracked progress, and supported real-time interaction. Mixed-method data from surveys revealed that students perceived the experience as engaging, motivating and skill-enhancing. Notably, the escape room succeeded in providing authentic opportunities for applied learning, particularly in communication and teamwork under time constraints. This paper contributes to the growing field of gamification by demonstrating how escape rooms can serve not only as motivational tools but also as practical, narrative-driven assessment methods. The integration of physical, digital, and collaborative components bridges the gap between theoretical knowledge and real-world application, offering compelling model for immersive learning and evaluation in computer science education.

Keywords: Escape rooms, Gamification, Computer science education, Educational innovation, Higher education, Immersive learning

1. Introduction

In recent years, the rapid advancement and widespread availability of artificial intelligence (AI) tools have significantly transformed the educational landscape. While these technologies offer powerful support for learning and creativity, they also introduce new challenges for educators: determining whether students are genuinely mastering foundational problem-solving skills has become increasingly difficult, particularly in fields like computer science. Traditional assessments, such as written exams, may offer partial insights into individual understanding but often fail to foster engagement or reflect real-world applicability. This raises a critical question: how can we design assessments that not only evaluate students' authentic capabilities but also encourage motivation, creativity, and critical thinking?

1.1 Gamification in Education

Gamification refers to the application of game-like elements in non-game contexts to enhance user engagement. (Deterding et al., 2011). This approach applies mechanics such as points, levels, and challenges to increase user engagement and motivation. Although it originated in marketing and UX, gamification is now widely adopted in diverse domains. Research suggests that gamified systems can significantly influence user behavior, by making tasks more immersive and engaging (Hamari, Koivisto and Sarsa, 2014).

Games are increasingly being used in education to enhance student interest, imagination, and academic performance. When integrated effectively, game-based elements can foster active learning, collaboration, and enjoyment (Domínguez et al., 2013). Gamified methods incorporate elements of competition, incentives, and storytelling from game design into the learning process, enhancing the learning experience (Karl, 2012). Subhash and Cudney (2018) emphasize that well-designed gamified environments can support learning outcomes by providing continuous feedback, promoting competition, and stimulating intrinsic motivation. However, implementation must align with pedagogical goals to avoid superficial engagement.

Theoretical concepts taught through traditional methods help facilitate the understanding of other theoretical concepts. Still, they are not particularly effective in developing the problem-solving and critical thinking skills necessary for computer science, which can only be learned through hands-on experience.

Recent applications of gamification in educational contexts have demonstrated its versatility and impact across diverse learning environments. For example, Narváez-Terán and Martínez Elizalde (2023) developed a turn-based card game to support the learning of regular languages in computer science education. The game incorporated core theoretical concepts—such as regular expressions, concatenation, and Kleene operators—

into its mechanics, enabling students to engage in hands-on pattern recognition and decision-making in a collaborative format. Similarly, Martínez Elizalde and Astengo Noguez (2022) implemented a gamified learning experience in a digital animation program, where students designed interactive products such as visual novels and games to promote independent literature. This challenge-based approach used narrative and game elements to make abstract programming concepts more tangible and relevant. These examples illustrate how gamification can promote motivation, deepen conceptual understanding, and foster transferable skills through engaging and context-rich activities.

This study examines the application of gamification in a Computer Science class on Software Construction and Decision Making at the undergraduate level. Principal technical fields include web development, database management, and video game creation. To foster deeper engagement and critical thinking, students participated in a collaborative storytelling activity that encouraged them to apply their knowledge in a playful, narrative-driven setting.

1.2 Escape Rooms as a Gamified Educational Tool

Escape rooms – games in which participants solve puzzles under time constraints to achieve a goal – have been increasingly adopted in educational settings to promote active learning and the practical application of knowledge. According to Cordero (n.d.), escape rooms are games that enable learners to acquire competencies and solve problems. Such experiences can be beneficial in educational settings as a means of engaging with complex ideas and promoting the practical application of knowledge.

Veldkamp et al. (2020) found that educational escape rooms can effectively promote critical thinking, teamwork, and applied learning. Similarly, Hermanns et al. (2017) reported increased motivation and knowledge retention in health sciences education through escape room experiences, suggesting broader applicability to fields such as computer science, where real-world scenarios often involve solving complex problems under pressure.

2. Methodology

2.1 Integrating the MDA Framework Into Gamified Educational Design

To deepen the theoretical foundation of gamification in education, the Mechanics–Dynamics–Aesthetics (MDA) framework offers a structured approach to game design that can be effectively applied to educational contexts. Developed by Hunicke, LeBlanc, and Zubek (2004), the authors emphasize that "from the designer's perspective, the mechanics give rise to dynamic system behavior, which in turn leads to particular aesthetic experiences".

Applying the MDA framework to educational game design allows educators to craft experiences. By carefully designing the mechanics (e.g., incorporating problem-solving challenges), educators can influence the dynamics (e.g., promoting collaboration and critical thinking), ultimately leading to positive aesthetics (e.g., increased motivation and engagement).

2.2 Design Process

This activity followed the escape room concept in that student teams took on a series of connected challenges within a time limit. Our intervention incorporated collaboration, planning, and narrative elements that promote both cognitive and interpersonal skills. The escape room was inspired by the magical universe of Harry Potter, because it offers rich thematic material for designing immersive learning environments (Rowling, 1997-2007). A fictional storyline was used to recall previously learned material while encouraging collaboration, critical thinking, and creative problem-solving.

This study builds on our previous research exploring how storytelling and gamification the learning experience and reinforce course objectives (Gonzalez and Solis, 2024). Unlike previous implementations that focused primarily on motivation, this project investigates the potential of the escape room format to function as a formative assessment tool. By embedding course content into the escape room's design, the activity aimed to assess students' practical capabilities in applying theoretical knowledge, solving problems, and working collaboratively under realistic constraints. In doing so, it offers an innovative model for evaluating student performance in higher education through immersive, game-based learning experiences.

In the context of our study, the escape room activity inspired by the Harry Potter universe exemplifies the MDA framework in action. The mechanics involved puzzles and challenges rooted in computer science concepts. The dynamics emerged as students collaborated to solve these challenges under time constraints,

fostering teamwork and critical thinking. The aesthetics were reflected in the students' heightened engagement and enjoyment, demonstrating the effectiveness of the MDA framework in educational gamification.

This study utilized a Harry Potter escape room as a gamified learning intervention in an undergraduate computer science course. It covered the design, implementation, and evaluation of an activity aimed at increasing student engagement, creativity, and problem-solving skills. The escape room featured six sequential missions that combined cognitive and physical challenges to provide an engaging, hands-on learning experience.

Two primary considerations shaped the design process: creating an engaging narrative environment and aligning game-based tasks with the course's learning objectives. The Harry Potter theme had broad cultural resonance and could motivate in a familiar context. The placement of the activity within a magical, story-driven framework increased students' enthusiasm for learning.

The educational objectives of the escape room were to enhance logical reasoning and collaboration and to provide students with real opportunities to apply the technical skills they had acquired during the course. Every mission had specific content areas, such as web development, database management, and game design, but also encouraged teamwork, strategic thinking, and effective communication.

Unique to the escape room was a custom Unity video game projected in the classroom that served as the central guiding interface. This digital component performed several key functions: It introduced the narrative and mission sequence to immerse participants in the gamified context. It enabled the tracking of 30-minute sessions and team progress in real-time, sustaining engagement and informing strategic planning. Moreover, it provided mission-specific instructions and a context-sensitive hint system to assist participants without interrupting the problem-solving process.

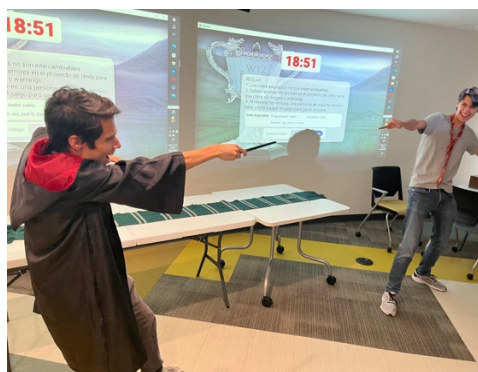


Figure 1: A Unity video game projected in the classroom

The following section outlines the design of the six missions and explains how each was aligned with the intended learning outcomes for the course.

3. Escape Room Design

By embedding theoretical concepts into engaging, narrative-driven tasks, the escape room format allowed students to demonstrate learning through action rather than recall. In doing so, the activity addressed the core problem outlined at the beginning of this study: how to design assessments that move beyond traditional exams to evaluate authentic capabilities while fostering motivation and critical thinking. The mission sequence served as a formative assessment tool that revealed individual and group competencies in a dynamic, low-stakes environment—providing educators with richer insights into student understanding and development within a computer science context.

3.1 Mission 1: Letters to Hogwarts

Designed to engage students with the gamified experience from the outset. This mission involved chance, teamwork, and quick decision-making—the precursor to the interactive, narrative challenges that followed.

Students encountered 10 identical envelopes hanging from the ceiling at different heights throughout the room. Every envelope had a code written inside. However, just one envelope carried the correct code to

unlock a treasure chest located in the mission area. Only one envelope at a time should be picked and opened; they had to wait for that code to be tried at the lock before choosing a different envelope.

The fact that all envelopes were visually identical was an intentional choice that added a degree of chance to the task. Randomly selecting the correct envelope meant participants could not rely on visual cues to identify the code. They instead had to try codes out by hand until they found the one that opened the chest through trial and error. This design choice introduced unpredictability, making the mission a game of chance and a test of quick decision-making.

The hypothesis for this mission was that *restricting the team to drawing one card per attempt would encourage better communication and organizational strategies.*

3.2 Mission 2: Quidditch Game

A dynamic, physical activity inspired by the wizarding sport of Quidditch from the Harry Potter universe - after completing the first mission. This mission introduced physical skill and chance while also emphasizing teamwork, coordination, and the immersive narrative.

When students opened the treasure chest at the end of the first mission, they found several ping pong balls representing the Quaffle in Quidditch. This transition between tasks kept the escape room flowing and students engaged. Discovering the ping pong balls connected the narrative elements of the escape room and created anticipation for the next challenge.

The setup included three hoops at different heights, representing the three Quidditch goals. The hoops were placed in a play area where participants stood on them. Hoops were placed at various heights to simulate competitive play in the original game.

For this mission, each student had to get a ping pong ball through one of the three Quidditch hoops. The task required participants to demonstrate accuracy, hand-eye coordination, and a competitive spirit. Rules for missions appeared on the Unity game interface, requiring all team members to take turns throwing a ball. The recorded order of successful goals was then updated on the projected leaderboard.

The hypothesis for this mission was that *faster teams, which complete this mission, demonstrate greater trust and shared motivation.*

3.3 Mission 3: Triwizard Tournament

A more technically demanding software development and debugging task. During this mission, students were assessed in both coding and problem-solving, utilizing a collaborative environment to simulate real-life team dynamics encountered in software engineering projects.

The mission started when the last student scored in the Quidditch Game. Transitions between missions were instantaneous to maintain a seamless and continuous escape room experience. A unity game interface projected on a screen during the activity announced the start time of the Triwizard Tournament and assigned roles based on previous task completion.

The order in which they scored was ranked from 1 to 6. Moreover, the role assignment was as follows:

- **Programmer:** That student who scored first was the programmer. This was the only team member allowed to modify the code directly on the computer.
- **Assistant:** A second-place student served as assistant. This participant watched the programmer on screen but was unable to modify the code.
- **Tech Support:** Students who scored between 3 and 6 were assigned to tech support roles. Tech support members could not see the screen directly, unlike the assistants. Then they were to answer any questions the programmer or assistant might have.

Roles rotated every 3 minutes, allowing everyone to participate in the mission in different ways. For example, the assistant became the programmer, the third position (tech support) became the assistant's role, and the programmer moved to the end of the line to take on tech support.

The hypothesis was that this *role rotation enables team members to develop technical communication skills.*

This rotating structure reinforced the collaborative nature of the task by allowing students to experience all aspects of problem-solving. Rotating roles also helped promote good communication among all team members, ensuring that the mission could depend on them working together effectively across different roles.

The Triwizard Tournament mission required participants to debug a preconfigured Unity project with various embedded errors. These included syntax errors, such as missing semicolons and incorrect function calls, as well as logical errors like faulty conditionals or loops, and missing or misconfigured scene components. The activity assessed students' programming skills, problem-solving abilities, and familiarity with the Unity development environment.

A new gameplay element was added once the programmer fixed the errors, and the Unity game ran successfully. A maze game appeared in the Unity project after debugging was finished. The programmer who had been debugging the project was now assigned to solve the maze. The transition of control stressed adaptability and ensured that each role contributed to the mission in its own way. When the labyrinth was completed, it gave a code to the next mission. This code had to be entered into the Unity-based mission control interface to advance the team.

3.4 Mission 4: The Dungeons

Explored database management concepts through a virtual reality (VR)- enabled format. Keeping the same physical room where the escape took place, the team selected a wand to attach to a spinning wheel, which would randomly select one student to be the Chosen One. A VR headset was placed on this student, who was transported into a virtual dungeon filled with a magical ambiance and enchanted books.

The hypothesis for this mission was that *using Virtual Reality in a gamified dynamic motivates the immersed user and encourages teamwork on theoretical activities, such as database management.*

Every book in the VR dungeon contained a secret question about database concepts like Data Retrieval, Data Filtering, Data Aggregation, and Joins. The Chosen One entered the virtual reality environment and read the questions from the books. Meanwhile, the rest of the team could only see the real world with a large board with a list of possible multiple-choice answers. They were required to match the questions to the correct answers on the board.

Once questions matched answers, students gathered the numbers to form a multi-digit code. This was entered into the Unity-based mission control interface for the next phase of the escape room experience.

3.5 Mission 5: Potions Class

Involved web development and debugging. This task tested their programming skills and included a puzzle-solving component that required technical problem-solving and creativity.

The hypothesis for this mission was that *cooperative error resolution encourages computational thinking and knowledge transfer among peers as students worked together to troubleshoot and fix issues in a web application.*

The same Programmer, Assistant, and Tech Support roles were used, along with a 3-minute rotation. However, in this case, the positions were inverted: the programmer was in the sixth position, the assistant in the fifth, and the tech support team moved from fourth to first.

Starting the mission, the team ran across a web application claiming to be a potion recipe tool. However, it had bugs like broken links, C# Syntax Errors, and Logical Bugs. The task was straightforward: debugging the web application and restoring its functionality. The Programmer worked through the code, the Assistant offered help or suggestions, and the Tech Support member provided technical assistance based on their understanding of the problem.

Once that was fixed and the application worked properly, the next challenge was a potion puzzle inside the web app. Every Potion Card student drew had a symbol or ingredient tied to an application action or form input. Students used these clues to "brew" the potion by selecting the correct ingredient combinations and completing the app actions. The application then displayed a code to enter the Unity-based mission control system once the potion was made. That code got them to the last mission of the escape room.

3.6 Mission 6: Helping the Snitch

A physically demanding challenge that tested students' teamwork, coordination, and problem-solving skills under pressure. It was a culminating activity that tested students' strategic thinking and collaboration in a real-life situation.

It began with retrieving the Golden Snitch, a golf ball hidden in the last treasure chest. The goal: Get this Snitch from A to B with only half-pipes - plastic channels that simulate the precise, delicate manoeuvring required in Quidditch. Any direct physical contact with the ball was prohibited, adding an extra level of difficulty and emphasizing the importance of coordination.

The hypothesis for this mission was *that cooperative physical activities would improve participants' perception of teamwork and coordination*.

Students planned and communicated as they adjusted the position and angle of the half-pipes to direct the ball into a final cup at the end. This cup had a button mechanism at its base. When it was pressed, the last code was displayed on an LCD screen. It was this code that had to be entered into the Unity-based mission control game to stop the previous countdown and exit the escape room.

This strategically embedded component was analogous to real-world engineering tasks, where teams must coordinate their actions toward a common goal. Team members each took on an active role in the task; students naturally assumed roles as navigator, communicator, and handler of the pipes, although no formal rotating roles were assigned for this mission. Teamwork requires constant verbal communication and non-verbal coordination, highlighting the importance of collaborative problem-solving.

The sixth hypothesis was demonstrated by this last challenge: cooperative physical activity enhanced participants' perception of teamwork and coordination when faced with high-stakes, time-sensitive tasks. The mission marked an end to a magical journey that students described as a shared success.

4. Implementation

4.1 Student Teams Constraints

The escape room was set up in a specially designed room, distinct from the classroom, with theme-appropriate music playing, and each mission was assigned to a designated station. The physical setup was intended to create an immersive atmosphere, incorporating themed decorations and props that enhanced the Harry Potter experience. Students were divided into teams of 6 members to encourage active participation and maximize the opportunities for collaboration. The group size was chosen to allow all participants to contribute meaningfully while still being manageable within the time constraints.

Only one team was allowed inside the Escape Room at a time to ensure the best experience for all teams. A 30-minute time limit was enforced to simulate the pressure of an escape room scenario, encouraging quick thinking and efficient problem-solving.

4.2 Data Collection Instruments

To capture students' perceptions and assess the pedagogical impact of the escape room, data were gathered using a combination of quantitative and qualitative tools. A post-activity survey was designed and administered immediately after students completed the experience. The survey included Likert-scale questions to measure engagement, enjoyment, perceived learning, collaboration, and the overall effectiveness of the activity as a learning strategy. To enrich the quantitative findings, the survey also featured open-ended prompts inviting students to reflect on what they learned, the challenges they encountered, and their impressions of the format. This mixed-methods approach allowed for a more holistic understanding of the students' experiences, combining measurable trends with personal insights.

5. Results

5.1 Qualitative Findings

To visualize students' reflections on the escape room activity, a word cloud was generated to represent the most common terms used by participants. Key words such as "fun," "challenging," and "collaborative" suggest that students found the activity enjoyable while engaging in teamwork and problem-solving. Other frequently mentioned descriptors, including dynamic, interesting, magical, and exciting, highlight the immersive and novel nature of the tasks. Words like "Strategy," "Teamwork," and "Communication" suggest that the escape room effectively fostered essential skills in a software engineering context.

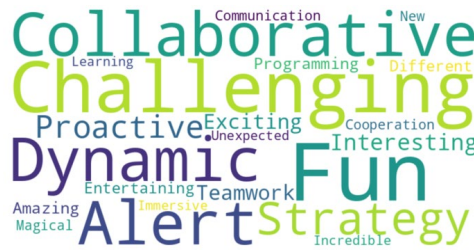


Figure 2: Word cloud of the most common terms used by participants in open-ended questions

5.2 Quantitative Findings

5.2.1 Communication and organization strategies (Mission1)

Drawing one card per attempt would encourage better communication and organization strategies within the team. This hypothesis was evaluated using two survey questions (Fig. 3):

- One letter per attempt forced us to communicate clearly
- I think that restriction helped us divide roles more evenly.

The responses confirm the hypothesis. The rule helped students clarify and organize their communication with teammates, most students said. They said it also distributed roles more evenly. This suggests that constraints promote structured teamwork and thoughtful collaboration. The figure below shows response data for these two questions.

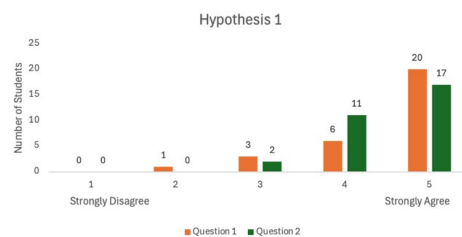


Figure 3: Distribution of the responses on a scale from 1 to 5

5.2.2 Trust and shared motivation (Mission 2)

Faster teams would exhibit greater trust and shared motivation. To test this hypothesis, three survey questions were used (Fig. 4):

- I felt like my team trusted me during this mission
- All team members were equally motivated to achieve this
- We coordinated quickly without much planning

Answers to such questions confirm our hypotheses. Most students reported feeling trusted by their teammates and that all members were equally motivated to complete the task. They said their team acted quickly without much planning. Since all teams completed the mission within two to three minutes, these results support the hypothesis that trust, motivation, and efficient collaboration contributed to their performance. The figure below shows response data for these three questions.

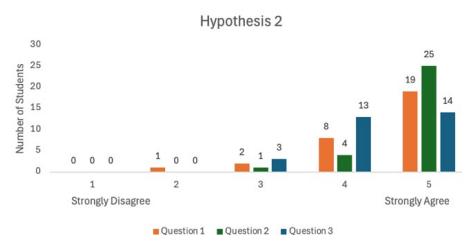


Figure 4: Distribution of the responses on a scale from 1 to 5

5.2.3 Technical communication skills (Mission 3)

Team members would develop technical communication skills by rotating through various roles. To evaluate this, three survey questions were used (Fig. 5):

- Rotating roles helped everyone participate in the solution
- I felt more comfortable communicating technical ideas by having a specific role
- The change of roles made me better understand my colleagues' ideas

The survey results support this hypothesis. Most students felt role rotation promoted full participation and helped them understand teammates' perspectives. A majority also stated that defined roles helped to express technical ideas. Such findings suggest rotating roles promote active engagement and technical communication within teams. Detailed response data for these three questions is shown in the Figure below.

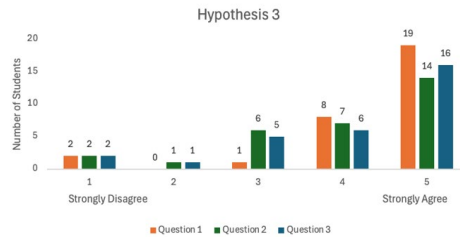


Figure 5: Distribution of the responses on a scale from 1 to 5

5.2.4 Motivation and teamwork (Mission 4)

The use of Virtual Reality in a gamified dynamic would motivate the immersed user and encourage teamwork during theoretical tasks, such as database management. To evaluate this hypothesis, the questions were different for students using the VR headset and for those who did not use it. VR users responded to (Fig. 6):

- The experience of using Virtual Reality made me feel more involved in the topic of databases
- I felt responsible for guiding and supporting my team through the VR experience

Moreover, the non-VR participants responded to (Fig. 6):

- I felt like the mission kept me motivated to participate, even when I was not wearing the headset
- I felt engaged with the team by having to answer questions

Most of the VR users agreed with the questions, which showed increased engagement with the topic and a greater sense of team responsibility. Meanwhile, almost all these students also reported being motivated and engaged, even though they were not using the VR. These results confirm our hypothesis that the VR-based dynamic was able to promote both individual and collaborative participation. Graphs of survey responses for those questions are shown below.

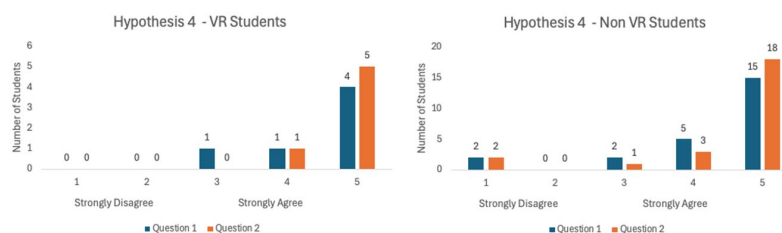


Figure 6: Distribution of the responses on a scale from 1 to 5

5.2.5 Computational thinking and peer-to-peer knowledge (Mission 5)

Cooperative error resolution would foster computational thinking and peer-to-peer knowledge transfer as students worked to troubleshoot a web application. This was assessed via three survey items (Fig. 7):

- Troubleshooting as a team helped us better understand how the web application works
- We share technical knowledge among team members during the mission
- I felt like this mission strengthened my computational thinking.

All three statements were agreed upon by most students, indicating that teamwork during debugging improved both technical comprehension and algorithmic thinking. These findings confirm the hypothesis that collaborative troubleshooting is an effective method for understanding and exchanging knowledge. The graph below shows survey responses.

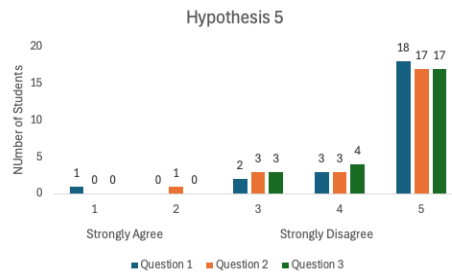


Figure 7: Distribution of the responses on a scale from 1 to 5

5.2.6 Teamwork and coordination (Mission 6)

Cooperative physical activities would increase participants' impression of teamwork and coordination. This is being evaluated using three survey questions (Fig. 8):

- This activity improved my perception of how we work as a team
- I felt that a high level of coordination was necessary to achieve the objective
- I had fun and thought it was a good way to close out the Escape Room

Most students agreed with all three statements. Additionally, the enjoyment of participants indicates that physical and playful components enhance collaborative experiences. The survey responses are shown in the Figure below:

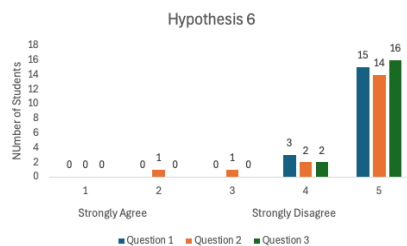


Figure 8: Distribution of the responses on a scale from 1 to 5

5.3 Teacher Findings

The hybrid design of the escape room—combining physical and digital elements—created a dynamic learning environment that fostered communication, collaboration, and application of technical knowledge. Each mission targeted specific skills: Mission 1 emphasized clear, efficient communication and task delegation; Mission 2 fostered urgency, trust, and coordinated action under pressure; Mission 3 highlighted the importance of technical communication through rotating roles; Mission 4 promoted asymmetrical collaboration and reinforced SQL concepts in a gamified setting; and Mission 5 focused on collaborative debugging, encouraging problem-solving and knowledge transfer. Collectively, these missions provided meaningful insights into how gameplay can support active, team-based learning in a technical context.

6. Conclusions

This study set out to explore how gamified assessments—specifically, an educational escape room—could provide an effective alternative to traditional evaluation methods in a computer science course. Faced with the growing challenge of assessing students' authentic problem-solving abilities in the era of AI-assisted learning, the goal was to create an assessment experience that not only tested knowledge but also encouraged creativity, engagement, and collaboration.

The results suggest that escape rooms, when grounded in pedagogical objectives and enriched with narrative-driven design, offer a promising solution. Students demonstrated high levels of motivation, enjoyment, and teamwork throughout the activity. Both qualitative and quantitative feedback indicated that the escape room

not only enhanced student engagement but also supported the development of key competencies in software construction and decision-making, such as logical reasoning, collaborative problem-solving, and critical thinking.

By aligning game mechanics with course outcomes and incorporating the MDA framework, the escape room provided an immersive and formative assessment experience. Unlike conventional tests, it evaluated students' applied skills in real time, under conditions that mirror the fast-paced, collaborative nature of real-world software development.

In conclusion, gamified assessments like educational escape rooms can serve as valuable tools in higher education—particularly in technical disciplines—by bridging the gap between content mastery and skill application. They offer an innovative and scalable model for authentic assessment that not only measures learning but also inspires it.

Ethics Declaration: Formal ethical clearance was not required for this study. Students were invited to complete an open survey voluntarily, and it was clearly stated that their responses could be used for research purposes. Participation was entirely optional, and no identifiable personal data was collected.

AI Declaration: Grammarly, an AI-powered writing assistant, was used during the preparation of this paper. The tool supported the revision process by identifying grammar, spelling, and punctuation issues and suggesting improvements for clarity and conciseness. All suggestions provided by the tool were carefully reviewed and selectively applied by the author to maintain the intended meaning and academic tone of the paper.

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