

3 Level Game for the First-Year Students in Computer Science

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The European Conference on Education 2026
Official Conference Proceedings

Abstract

This study explores the use of gamification and Generative AI to enhance engagement and learning outcomes to “*Design, build, and test front-end web pages according to specifications and best practices*” in introductory web development education. It addresses the research question: “*To what extent can a gamified, AI-supported learning intervention improve first-year students’ understanding of HTML and CSS while promoting meaningful engagement?*” A three-level HTML & CSS Mastery Game was designed and implemented within a Web Applications module at Cardiff University. It comprises: (1) *Builder Basics*, focusing on HTML structure through interactive drag-and-drop tasks; (2) *CSS Styling*, requiring students to complete code based on design prompts; and (3) *Guess the Tag*, reinforcing conceptual understanding through matching activities. Generative AI contributed to the pedagogical design by supporting the creation of varied task instances, generating immediate and adaptive feedback, and enabling scalable content development. Its use was guided by principles of responsible AI, ensuring transparency, accuracy, and alignment with educational objectives. A mixed-methods research approach was adopted with 260 first-year students, combining quantitative performance data with qualitative feedback from 73 questionnaire responses. Findings indicate increased student engagement, improved conceptual understanding, with participants reporting higher motivation and a preference for the gamified approach compared to traditional formative assessments. This study contributes to the field of higher education pedagogy by presenting a scalable framework for integrating gamification and Generative AI into computing education. It highlights how AI can be used to enhance active learning and formative assessment while maintaining pedagogical integrity and supporting inclusive education.

Keywords: gamification, generative AI, formative assessment

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Introduction

Gamification in higher education has an important role in boosting student motivation, engagement, and cognitive performance. Applying gamification in formative assessment leads to increased student engagement, improved conceptual understanding, higher motivation and a preference for the gamified approach compared to traditional formative assessments.

In recent days Artificial Intelligence (AI) has been employed in every area of science, business and everyday life. Therefore, It is essential to employ the assistance of Generative AI in designing learning materials and assessments to support the creation of varied task instances, generate immediate and adaptive feedback, and enable scalable content development.

Literature Review

According to Ortiz et al. (2016) in recent years, gamification, the use of game elements in non-game contexts, has drawn the attention of educators due to the possibility of making learning more motivating and engaging. Analysis results show how a combination of game elements (e.g. leaderboards, badges, points and other combinations) positively affects students' performance, attendance, goal orientation and attitude towards mostly computer science related subjects.

The study in Gyedu et al. (2026) highlights the importance of context-specific and theory-driven gamification strategies tailored to learners' needs and institutional environments. In conclusion, findings affirm that when carefully implemented, gamification is a powerful tool for improving learning outcomes in higher education.

The results from the research conducted in Camacho et al. (2026) show that the integration of game mechanics —such as points, levels, challenges, and rewards— increases student motivation and commitment, facilitates the development of critical thinking, communication, and teamwork, and redefines the role of the teacher as a designer of training experiences.

Therefore, there is a need to explore the use of gamification and Generative AI to enhance engagement and learning outcomes in introductory web development education. This study contributes to the field of higher education pedagogy by presenting a scalable framework for integrating gamification and Generative AI into computing education.

Nowadays, Artificial Intelligence (AI) has a dramatic impact on our everyday lives and in particular on Higher Education (HE). Therefore, since universities need to prepare the students for the industry, it is extremely important that the HE sector stays informed of developments in AI and commit to ongoing research and discussions regarding best practice in accommodating AI in learning and assessment.

Besides mentioning challenges for HEIs, some authors also see opportunities for student learning, feedback, and assessment design. Bobula (2024) emphasises the positive role AI can play in education.

Furthermore, AI-supported educational tools enable personalized learning by identifying individual students' strengths and weaknesses and providing precise performance assessments as mentioned by Chen et al. (2022). The authors in Francis et al. (2025) propose a set of

recommendations for educational institutions, including developing GenAI literacy programmes and revising assessment designs to incorporate critical thinking and creativity.

Generative AI – ChatGPT

ChatGPT is an AI language model developed by OpenAI that is designed to understand and generate human-like text based on the input it receives. It uses machine learning, particularly a type of neural network called a Transformer, to generate coherent and contextually relevant responses. Trained on vast amounts of text data from various sources, it can assist with a wide range of tasks, including answering questions, providing explanations, generating creative content, coding, tutoring, and more.

Key features of ChatGPT include:

- **Natural Language Processing (NLP):** ChatGPT can understand and generate text in a conversational style, making interactions feel more human-like.
- **Wide Range of Topics:** It is knowledgeable in many areas, such as science, history, technology, arts, entertainment, and much more.
- **Context Awareness:** ChatGPT tries to maintain context during a conversation, allowing for follow-up questions and more dynamic interactions.
- **Customization and Use:** It can be embedded in various applications or used for specific tasks like writing, customer service, and content creation.
- **Limitations:** While powerful, it may produce incorrect information, lacks real-time awareness, and has no understanding or awareness of personal context unless specifically shared during the conversation.

It is like an advanced chatbot with diverse applications in customer support, education, entertainment, and productivity.

Research Question

This study explores the use of gamification and Generative AI to enhance engagement and learning outcomes to “Design, build, and test front-end web pages according to specifications and best practices” in introductory web development education. It addresses the research question: To what extent can a gamified, AI-supported learning intervention improve first-year students’ understanding of HTML and CSS while promoting meaningful engagement?

The First-year students in Computer Science at Cardiff University have been enjoying active learning based on Generative AI methods of teaching and assessment. This study contributes to the field of higher education pedagogy by presenting a scalable framework for integrating Gamification and Generative AI into computing education. It highlights how AI can be used to enhance active learning and formative assessment while maintaining pedagogical integrity and supporting inclusive student engagement.

Methodology

Formative Assessment Through Gamification

Learning how to do web programming and design web sites can be sometimes too dry and boring. The First-Year students in Computer Science at Cardiff University found a more interesting way of learning through Gamification. Their knowledge about the Web

Applications module would be usually evaluated during the in-person sessions through Mentimeter and quizzes through which we can get some feedback about their learning, but it is not very specific and always follows the same format.

Therefore, we have designed with the help of Generative AI a simple HTML&CSS Mastery Game with 3 levels to evaluate the students' skills in web design.

Generative AI contributed to the pedagogical design by supporting the creation of varied task instances aligned with learning outcomes, generating immediate and adaptive feedback, and enabling scalable content development. Its use was guided by principles of responsible AI, ensuring transparency, accuracy, and alignment with educational objectives.

Game Implementation

Three-Level HTML & CSS Mastery Game

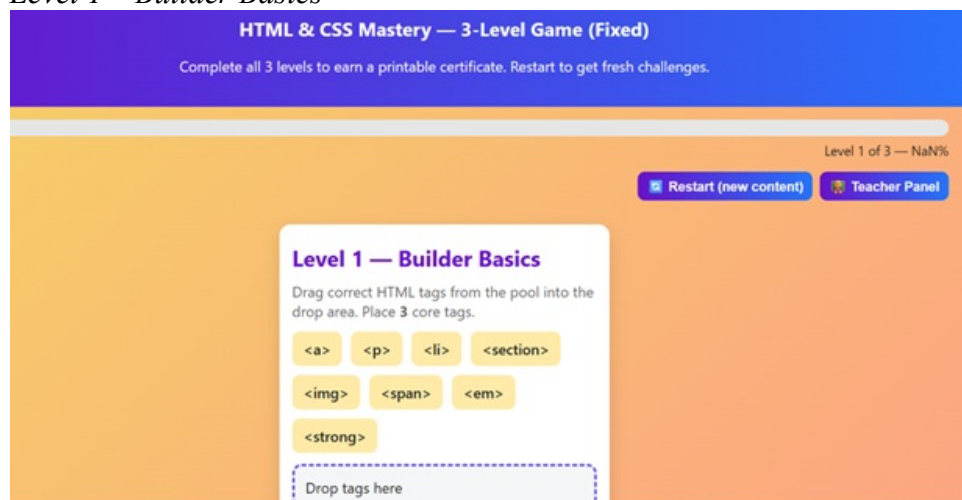
A three-level HTML & CSS Mastery Game was designed and implemented within a Web Applications module at Cardiff University for the 1st year students in Computer Science. The game comprises of:

1. **Builder Basics**, focusing on HTML structure through interactive drag-and-drop tasks;
2. **CSS Styling**, requiring students to complete code based on design prompts; and
3. **Guess the Tag**, reinforcing conceptual understanding through matching activities.

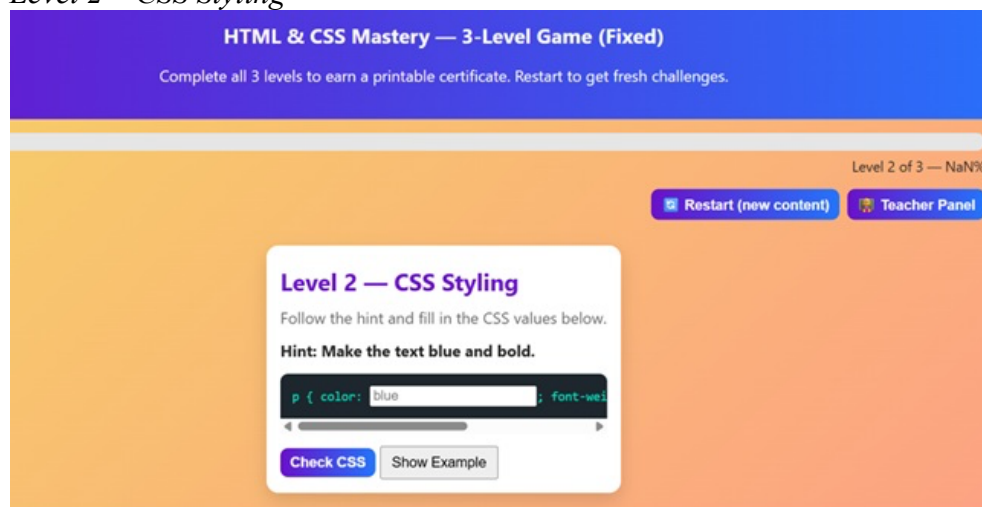
Feedback is provided for correct and incorrect answers. In addition, there is a progress bar during each level showing how much the student has achieved. Finally, a certificate is rewarded for the successful completion of the game.

Level 1: Builder Basics

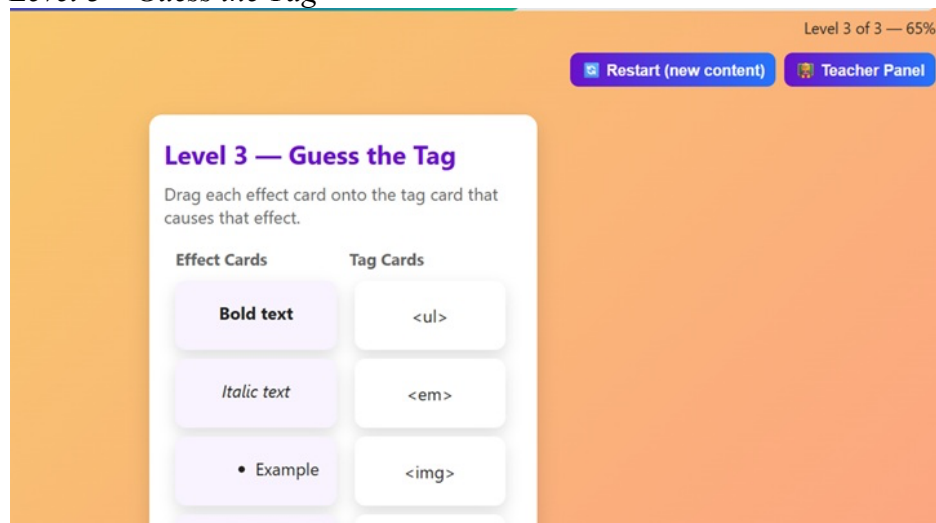
Level 1 is called Builder Basics and asks the students to drag the correct HTML tags from the pool provided into the drop area. The students are supposed to place 3 core tags and are provided with feedback which tags are correctly or incorrectly placed. An example of the Level 1 is presented in **Figure 1** below.

Figure 1*Level 1 – Builder Basics***Level 2 – CSS Styling**

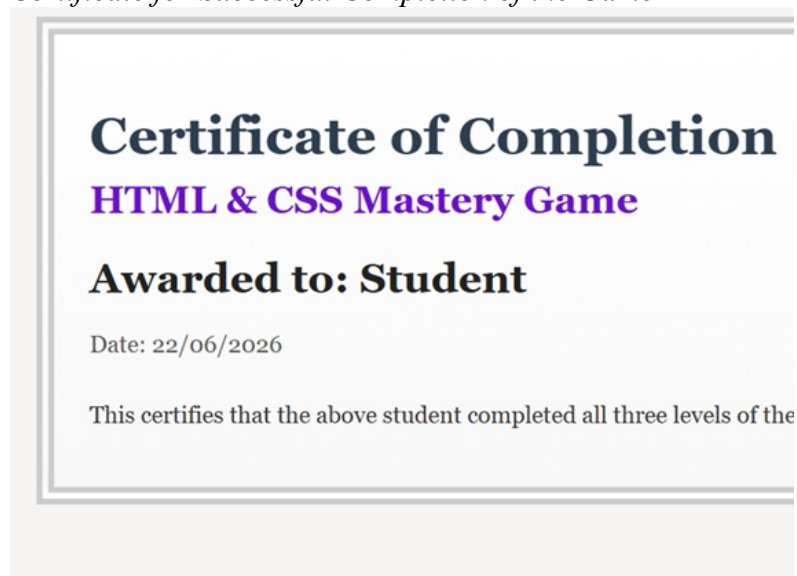
In Level 2 CSS Styling the students need to follow the hint and fill in the CSS values in the code below. (e.g. Hint: Make the text blue and bold). The students can check the correct CSS and are provided with feedback. An example of the Level 2 is presented in **Figure 2** below.

Figure 2*Level 2 – CSS Styling***Level 3 – Guess the Tag**

In Level 3 Guess the tag the students need to drag each effect card onto the tag card that causes that effect. The students can check the correct tag and are provided with feedback. An example of the Level 3 is presented in **Figure 3** below.

Figure 3*Level 3 – Guess the Tag*

On the successful completion of the game the students receive a certificate with their name for the completion of the HTML and CSS mastery game. An example of the certificate is presented in **Figure 4** below.

Figure 4*Certificate for Successful Completion of the Game*

Results and Discussion

A mixed-methods research approach was adopted with 260 first-year students, combining quantitative performance data with qualitative feedback from 73 questionnaire responses. The students' response was collected through their feedback to a Mentimeter quiz designed for that purpose. Findings indicate increased student engagement and understanding, with participants reporting higher motivation and a preference for the gamified approach compared to traditional formative assessments.

Key insights include:

- The game felt easy, but many still said they learned little, so the challenge may have been too low for retention.
- Hints and answer feedback were only partly clear, suggesting the core tags step needs simpler wording and examples.
- Enjoyment was generally positive, but confusion around “main” and “core” tags show the first level needs a clearer setup.

Conclusions and Future Work

This study contributes to the field of higher education pedagogy by presenting a scalable framework for integrating gamification and Generative AI into computing education. It highlights how AI can be used to enhance active learning and formative assessment providing pedagogical integrity and supporting inclusive education.

The key insights from the students’ feedback show that the game needs improvement. After conducting some further research into gamification additional ideas for future formative assessment have been generated, including online Escape room and a Quest game or Interactive game based on real-life scenario and AI song creation with lyrics based on Computer Science.

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