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Promoting academic integrity through gamification: Testing the effectiveness of a 3D immersive video game

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Abstract. Academic integrity is the foundation of quality higher education. However, the resources explaining the concept tend to be definition-driven, have complex language and sometimes even a severe tone to discourage students from breaking rules. This project deployed a gamified approach, designing and evaluating a 3D immersive video game for university students to facilitate their understanding and adoption of academic integrity principles. The game allowed students to be immersed in a virtual campus through an avatar and navigate a campus (e.g., garden, library, cafe, student accommodation) with scenario-based, academic integrity related dialogues with in-game characters. The paper aims to showcase the game design and student feedback of the game. Observation and interviews were conducted with 15 participants. Thematic analysis of the data shows that the game greatly enhanced student understanding of academic integrity concepts by providing contextualized memorability whilst relieving anxiety. Students' engagement with the game was linked to game features such as appealing aesthetics, customization, and contextualization. The paper concludes by offering recommendations concerning the employment of gamification as an educational approach for instructing students in higher education on complex concepts, such as academic integrity.

Keywords: Academic Integrity, Gamification, 3D immersive video game, game design, game evaluation.

1 Introduction

The escalating issues related to breaches in student academic integrity, whether inadvertent or deliberate, are increasingly challenging academic departments [1]. This necessitates a critical reflection on the mechanisms used to inform students about academic integrity and the prevention of academic misconduct. The most frequent incidents leading to such breaches are poor paraphrasing methods and inaccurate referencing formats, which often lead to instances of plagiarism [2].

Academic integrity as a concept is not universally comprehended. The myriad interpretations of academic integrity can sometimes result in misunderstandings among students and staff alike, thereby inadvertently fostering unethical academic

practices [3]. In recent years, universities have shown an increased commitment to addressing issues related to academic integrity [4]. However, the integration of these principles into teaching practices still leaves much to be desired [5,6].

The challenges have been amplified by the emergence of contract cheating and the use of ghost-writing services [7], compounded by a poor understanding of academic integrity practices due to cultural variances in highly internationalized student cohorts. This has necessitated the exploration of innovative approaches in the higher education sector to support and guide students [8].

Several researchers have underscored the importance of proactive strategies in fostering academic integrity among students as they transition into new academic environments [9,10]. One emerging approach is the use of gamification, although its application in promoting academic integrity is still in its infancy [7]. Gamification incorporates elements of gameplay, such as points and rewards, into the learning environment [11]. There is growing evidence that gamification can effectively facilitate learning by making it a more engaging and enjoyable process [7,12].

The aim of this study was to design and evaluate a 3D interactive video game in English for university students to facilitate their understanding and adoption of academic integrity principles. The design of the video game was based on a previous study which surveyed 400+ students to explore their learning needs in terms of academic integrity concepts [13]. The pedagogical basis for creating this resource stems from the concept of 'edutainment,' an approach that combines learning with entertainment, particularly through a gamification approach [14]. Edutainment focuses on transforming educational content into a game-like environment to facilitate enjoyable learning [15,16], while maintaining a harmonious balance between fun and educational value [17].

In this short paper, the design process of the 3D immersive video game is showcased. In addition, students' evaluations of the effectiveness of the game are presented through in-depth interviews.

2 Methodology

The process of designing, implementing, and evaluating the 3D immersive video game consists of three distinct stages. In the first stage, we developed a 3D video game based on the insights gathered from our previously published study, which involved conducting focus groups and surveys to understand students' learning needs regarding Academic Integrity (n=177). Moving on to the second stage, we conducted a pilot of the game and gathered valuable feedback from participants through interviews and observations (n=15). Subsequently, we refined the game based on the valuable insights obtained from the interview feedback. Finally, in the third stage, we officially launched the game and collected in-game data from a larger group of students (n=317), alongside an evaluation survey (n=257).

This paper primarily focuses on documenting the game design and refinement process, encompassing stages 1 and 2 (Fig. 1). Participants for this study were recruited through snowball sampling, initiated via university email announcements.

We achieved sample saturation by the 15th interview, as the emergence of recurring themes indicated no further insights [32]. The interview design was semi-structured, encompassing questions about demographics, game-related aspects (e.g., 'What feature of the game did you like most/least?'), academic content (e.g., 'Were the questions worded clearly?'), and observations (e.g., 'I noticed frequent clicks in a specific game area, could you elaborate?'). The project received ethics approval from the University of Sheffield.

Fig. 1. Stages of the study

2.1 Game design

The game creates a virtual campus that closely resembles a real educational institution. Players assume the role of a new student who has just arrived on campus and navigate the virtual environment using an avatar. They interact with other in-game characters, representing fellow students and help them with Academic Integrity related questions, through engaging dialogues. Players encounter four distinct scenes: the university garden, the academic library, the university cafe, and the student accommodations. Throughout these scenes, players are presented with 20 scenario-based academic integrity related quizzes.

The game was developed using the Unity game engine and programmed in C#. The Unity Game Framework is a modular framework that includes various modules, such as data syncing, special effects, player control, dialogue, and artificial intelligence (AI) for in-game characters. To enhance the player's experience, the game incorporated several elements for smoother gameplay. These included message panels, cursor animations, and in-game graphic tips that guided the player through conversations, navigating to destinations, transitioning between scenes, and more (Fig. 2).

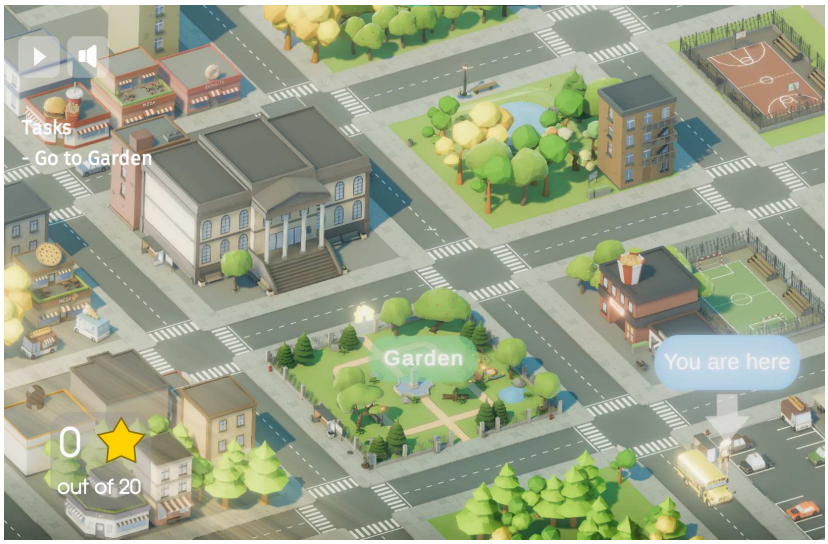

Fig. 2. An example of in-game tips.

In the game design phase, eye tracking technology was employed for usability tests of UI prototypes, as widely utilized in the field [18]. The attentional trajectory of participants was used to inform the development of the final UI design, ensuring that important information such as task prompts, scores, and dialogues were effectively presented to players (Fig. 3).

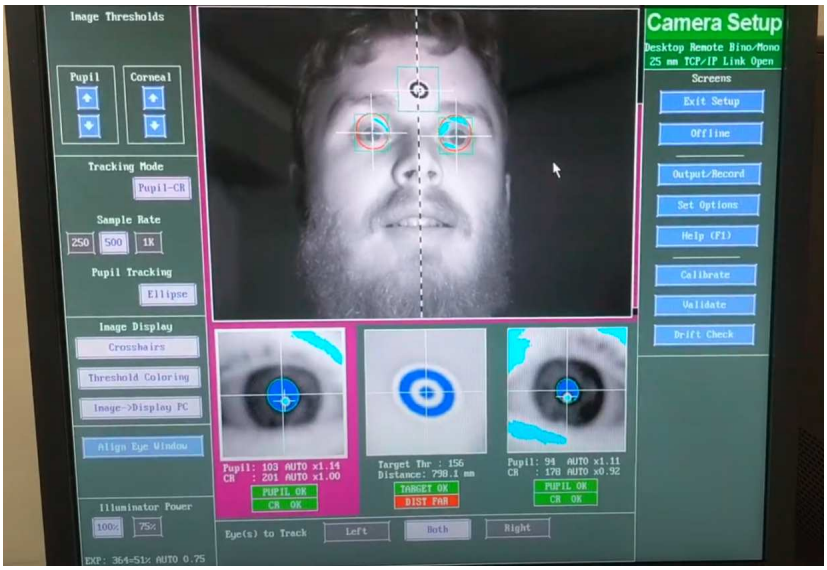

Fig. 3. An illustrative example of eye tracking technology adopted.

Players actively participate in quiz answering by engaging in dialogues with in-game characters (Fig. 4). The dialogue dynamically adjusts based on the player's responses, providing personalized feedback. Furthermore, to sustain motivation, the game incorporates a point-based system and a leaderboard (Fig. 5), encouraging players to strive for higher scores and fostering a sense of competition and achievement.

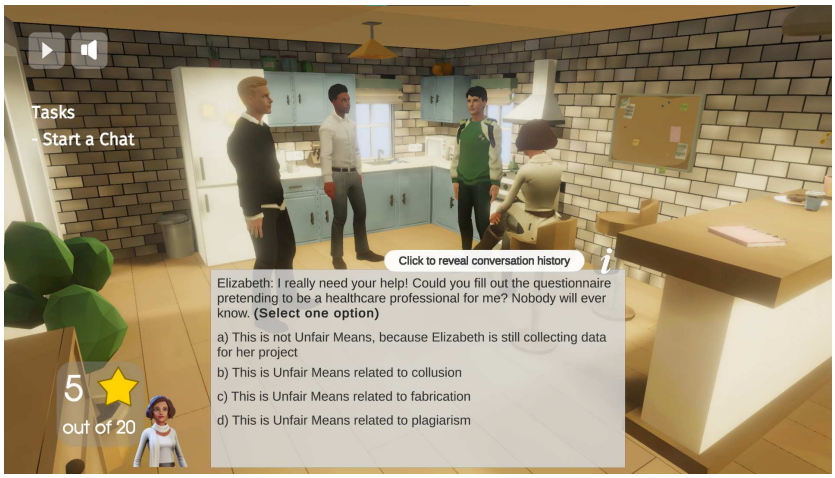

Fig. 4. Illustration of quiz UI.

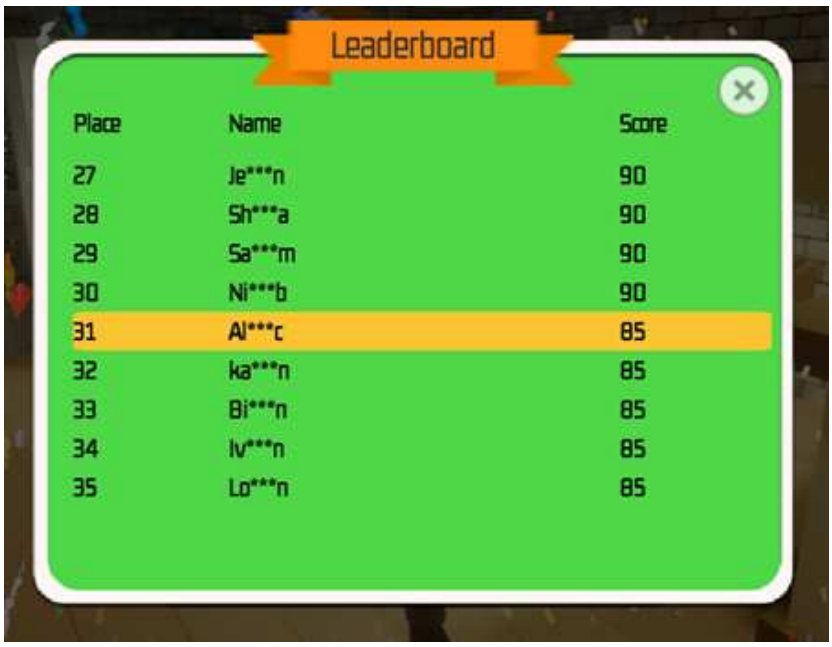

Fig. 5. Illustration of the leaderboard.

This game acts as a socio-technical structure, incorporating both technical elements and social interactions. Specifically, its technical aspects, such as programming and interaction mechanisms, create an interactive and immersive environment for the player. Players acquire social experience by engaging in conversations with other characters and exchanging body language, thus realizing the game's educational purpose. To enhance the game's realism and facilitate players' understanding and immersion in the textual storyline [19], rich character animations were employed to portray the emotions of in-game characters. These animations were implemented using humanoid animations controlled by a finite state machine (FSM) [20,21]. During conversations, players can perform various body gestures such as waving, nodding, and clapping, aligning their responses with the dialogue. Notably, when players provide correct answers, they are rewarded with congratulatory animations (Fig. 6), providing them with a more socially oriented incentive [22,23].

Fig. 6. In-game animations.

2.2 Interview process

The interviews were conducted either face-to-face or via Google Meets. During these interviews, students were asked to assess the gameplay and content of the game and provide suggestions for improvements in these areas. A total of 15 participants were recruited. The group consisted of 11 female and four male participants. The interview data were thematically analysed.

3 Results

The interview data revealed that the gamification of academic integrity provided an accessible, enjoyable, and engaging format from the three main perspectives: game design, academic knowledge (i.e., academic integrity contents) and usability.

3.1 Game design features

Four main topics were raised in relation to the design of the game. Students indicated that customization and the game aesthetics (music, art, and backgrounds) made the subject of academic integrity enjoyable, engaging and less anxiety-inducing [24]. Furthermore, the simplicity of the game and scoring system supported learning.

Customization. Many participants were initially intrigued by the game due to the ability to customize their avatars as personalisation provided enjoyment and direct choices for players:

> "I think it's very personalized because they allow me to choose the gender and clothes I like." [P13, Female, China]

Aesthetics. Aesthetic aspects continued to engage participants as the game progressed with the art and music engrossing participants into the subject matter [26]:

> "I really liked the aesthetics. I liked going into the park and then automatically I was like 'Oh, this is fun. Oh, there's a duck!'... It just brought some life to the game." [P10, Female, UK]

Simplicity. Students found that the simplicity of the gameplay, where players interacted with characters through text options, suited academic integrity and assisted their learning:

> "It was really helpful with a little list of what to do next… you literally just click where you wanna go and then the game does it for you so that was really helpful because it might have been quite frustrating." [P12, Female, UK]

Scoring system. With these features establishing a comfortable and accessible environment, participants noted that the high score system kept them hooked and motivated [25]. Participants especially appreciated the feedback they received on answers.

> "You give feedback for every question, it helps you more. I submit a lot of questions for [other] quizzes and they give me maybe the third [question], this one, this one. I'm like, what did I answer? I already forgot! But for the game, there's more immediate feedback." [P4, Female, China]

3.2 Academic knowledge

During the interviews, students reported increased engagement in academic integrity concepts.

Gamification inspires learning. Most students professed that the game taught or clarified key concepts of academic integrity that they found ambiguous, vague or were unaware of.

> "I got to know all about academic integrity. Now I'll be more cautious regarding writing my assignments… I learnt something from it… I think the information after answering each question, for me, I think that was very informative." [P1, Female, China]

Contextualization improves knowledge recall. Vital to learning new information is memorizing [27], as several participants discussed that gamifying the information assisted in recalling academic practices. Specifically, situating questions within a setting supported recollection of information which led to students comparing common resources and ranking their preference with the game being favoured:

> "The game is best and the quiz is second and the presentation is last… I can learn more, I can remember more things because the story happens and I can remember which area like a cafe and garden so I can totally remember it." [P15, Female, China]

Gamification relieves anxiety. As a result of gamifying academic integrity, the game reduced apprehension or uneasiness:

> "Throughout my degree, I found it quite anxiety-inducing thinking about Academic Integrity. I think having it in the form of a game for someone else to instruct you is quite helpful." [P12, Female, UK]

Students contrasted other academic integrity resources, such as presentations and quizzes, with the greater engagement, fun, and motivation they experienced with the game:

> "If someone is talking to you like the presentation, you can't remember anything important… if you are involved, you really read the question and make some answers. That is good. But for the quiz… I can imagine how boring it is. So a game will definitely be better." [P13, Female, China]

Through gamification, students exhibited an increased understanding of academic integrity as the game clarified concepts and made information memorable through setting and relatability. The game also reduced a barrier of uneasiness in initially

contemplating academic integrity. Therefore, participants expressed that teaching academic integrity is more effective and accessible through a gamified format, especially when compared to formats frequently used within universities of presentations and quizzes.

3.3 Usability

The participants highlighted several features that presented functional usability whilst also recommending improvements to the game that assisted in evaluating its impact on student learning. These aspects involved phrasing, contextual clarification, and emphasizing the gamification feel.

Phrasing. Whilst participants have cited how the customization, setting, and choices provide immersion and recollection of academic integrity, students also suggested that some phrasing of questions and responses disrupted the narrative and enjoyment of the game:

> "The least part of it was probably the questions. They are very stilted. They're like 'Oh, can you help me?'. They're not realistic. How they talk isn't real." [P3, Female, New Zealand]

Students recommended shortening, simplifying, or bullet-pointing key information to reduce the dependence on reading which would emphasize the gamified aspects over testing academic integrity knowledge.

Contextual clarification. Throughout the game, a narrative was developed by introducing contextual information before each question to assist in understanding academic integrity. However, participants indicated that they often forgot the prior discussions and would struggle to interpret the questions. Students recommended including a back button or information icon to repeat or summarize the information from these conversations between characters:

> "Sometimes when I select the answer and I forgot what the question is. So I want to turn back and look around but there is no function." [P15, Female, China]

Students also recommended functions to increase understanding of keywords. This often took the form of highlighting, underlining, or boldening these words. Participants whose first language was not English suggested keywords to have a pop-up definition which would quickly clarify terms.

Whilst participants expressed positive feedback on the game assisting memorizing key concepts, they also suggested this could be developed further with a summary page at the end of the game which would act as an overview for the questions with an indication of what academic integrity topics to revise and the information they may have missed:

"I think maybe a PDF copy of the questions to summarize and to get the results of which question you did wrong… Otherwise, when I close the game, I can't remember anything." [P13, Female, China]

Emphasizing gamification. As previously highlighted, the gamification of academic integrity was described as a more engaging and accessible format by participants. However, the extent to which gamification occurred was often perceived as short of the expectations or potential for the game. Participants wanted further gamification with some students perceiving the game as being more of a quiz than a game:

"It did feel kind of like a dressed-up quiz in a way. I'm sure there's some kind of gameplay mechanics that would have made it more gamey." [P2, Male, UK]

Participants suggested expanding the interactive aspects of the game to move it beyond the questions that served as one of the minimal player inputs. Therefore, participants expressed further interactions to make the gameplay more enticing, enjoyable, and engaging. These ranged from simple inputs of clicking on animals for noises to utilizing the map with additional, more varied questions to increase high scores.

4 Discussion and implications

This paper presents the design and evaluation of an educational game aimed at supporting student learning on the topic of academic integrity. The findings highlight the effectiveness of gamification approach in enhancing student engagement in learning academic integrity related concepts. The incorporation of appealing aesthetics, customization options, and simplicity in the game design were positively received by participants, making the learning experience enjoyable and less anxiety-inducing. Participants reported increased comprehension of academic integrity concepts through engaging dialogues with in-game characters, as the narrative nature provided relevant and relatable experiences that supported memorization and recollection. The game's affordance to simulate social scenarios related to unfair means plays a pivotal role in bridging the gap between theoretical knowledge and real-life application. By immersing students in these simulated environments, the game enhances their understanding of academic integrity principles and fosters the transferability of acquired knowledge to practical situations. This aspect greatly contributes to the overall comprehensibility and applicability of students' learning experiences. This finding is consistent with the research by Birk et al. [28], who suggest that when players identify with an avatar in a game, it can contribute to an enhanced immersive experience and increase intrinsic motivation for learning.

Our study provides compelling evidence that gamification is highly effective in promoting learning through entertainment [14], especially for topics that tend to induce anxiety, such as academic integrity. This accords with existing literature that

suggests gamification can enhance students' engagement, promote skills development, and optimize their learning [29]. The inclusion of gamification elements, such as a point system and leaderboard, contributes to enhancing intrinsic motivation among students. These elements provide students with clear goals and a sense of achievement, encouraging them to actively engage in the learning process. Additionally, the integration of achievement badges and congratulatory animations from other in-game characters serve as a rewarding mechanism, further incentivizing students to strive for excellence and perform their best [30,31]

Despite the overall positive feedback, some areas for improvements were identified during the evaluation. Participants expressed concerns about the phrasing of questions and responses, highlighting the need for more realistic and concise expressions. They also recommended an inclusion of a back button or information icon to review prior conversations and a summary page to consolidate learning outcomes. Additionally, participants desired further gamification elements to enhance interaction and engagement, suggesting the inclusion of more interactive features, varied questions, and optional landmarks for exploration.

Our research demonstrates the effectiveness of combining observational methods, such as eye-tracking, with follow-up interviews for data collection. This integrated approach has proven particularly valuable in enriching our data. It has informed the development of the game's UI design and enhanced the relevance of observation-related questions during the interviews.

One limitation of our work is the small sample size for the interviews, and the fact that all participants were postgraduates from the Faculty of Social Science. This restricted sample may limit the generalizability of our findings to a broader population. Furthermore, this study focused exclusively on students' engagement and perceived learning gains, rather than evaluating their actual understanding of academic integrity before and after playing the game. Therefore, our follow-up research (Phase 3) will concentrate on this particular aspect.

5 References

1. Gallant, T.B.: Academic integrity as a teaching & learning issue: From theory to practice. Theory Into Practice. 56, 88–94 (2017).
2. Greenberger, S., Holbeck, R., Steele, J., Dyer, T.: Plagiarism Due to Misunderstanding: Online Instructor Perceptions. Journal of the Scholarship of Teaching and Learning. 16, 72–84 (2016).
3. Palmer, A., Pegrum, M., Oakley, G.: A wake-up call? Issues with plagiarism in transnational higher education. Ethics & Behavior. 29, 23–50 (2019).
4. Burbidge, T., Hamer, R.: Academic honesty in the international baccalaureate diploma programme: Student, teacher, and school perspectives. Journal of International Students. 10, 265–285 (2020).
5. Bretag, T., Mahmud, S., Wallace, M., Walker, R., McGowan, U., East, J., Green, M., Partridge, L., James, C.: 'Teach us how to do it properly!'An Australian academic integrity student survey. Studies in higher education. 39, 1150–1169 (2014).

6. Gottardello, D., Karabag, S.F.: Ideal and actual roles of university professors in academic integrity management: a comparative study. Studies in Higher Education. 47, 526–544 (2022).
7. Khan, Z.R., Dyer, J., Bjelobaba, S., Gomes, S.F., Dlabolová, D.H., Sivasubramaniam, S., Biju, S.M., Hysaj, A., Harish, P.: Initiating count down-gamification of academic integrity. International Journal for Educational Integrity. 17, 1–15 (2021).
8. White, A.: Interactive approaches to learning about academic integrity: the role of fun and games. In: A Research Agenda for Academic Integrity. pp. 86–99. Edward Elgar Publishing (2020).
9. Bretag, T., Mahmud, S., Wallace, M., Walker, R., McGowan, U., East, J., Green, M., Partridge, L., James, C.: 'Teach us how to do it properly!'An Australian academic integrity student survey. Studies in higher education. 39, 1150–1169 (2014).
10. Newton, P.: Academic integrity: A quantitative study of confidence and understanding in students at the start of their higher education. Assessment & Evaluation in Higher Education. 41, 482–497 (2016).
11. Becker, K.: What's the difference between gamification, serious games, educational games, and game-based learning. Acad. Lett. 209, 1–4 (2021).
12. Furdu, I., Tomozei, C., Kose, U.: Pros and cons gamification and gaming in classroom. arXiv preprint arXiv:1708.09337. (2017).
13. Sbaffi, L., Zhao, X.: Evaluating a pedagogical approach to promoting academic integrity in higher education: An online induction program. Frontiers in Psychology. 13, (2022).
14. Aksakal, N.: Theoretical view to the approach of the edutainment. Procedia-Social and Behavioral Sciences. 186, 1232–1239 (2015).
15. Shulman, J.L., Bowen, W.G.: The game of life: College sports and educational values. Princeton University Press (2011).
16. Moreno-Ger, P., Burgos, D., Martínez-Ortiz, I., Sierra, J.L., Fernández-Manjón, B.: Educational game design for online education. Computers in Human Behavior. 24, 2530–2540 (2008).
17. Prensky, M.: Digital game-based learning. Computers in Entertainment (CIE). 1, 21–21 (2003).
18. Sunhem, W., Pasupa, K.: A Scenario-based Analysis of Front-facing Camera Eye Tracker for UX-UI Survey on Mobile Banking App. In: 2020 12th International Conference on Knowledge and Smart Technology (KST). pp. 80–85 (2020). https://doi.org/10.1109/KST48564.2020.9059376.
19. Taylor, M.J., Pountney, D.C., Baskett, M.: Using animation to support the teaching of computer game development techniques. Computers & Education. 50, 1258–1268 (2008).
20. Ho, E.S.L., Komura, T.: A finite state machine based on topology coordinates for wrestling games. Computer Animation and Virtual Worlds. 22, 435–443 (2011). https://doi.org/10.1002/cav.376.
21. Thorn, A.: Unity Animation Essentials. Packt Publishing Ltd (2015).
22. Nielsen, R.K.L., Grabarczyk, P.: Are Loot Boxes Gambling?: Random reward mechanisms in video games. Transactions of the Digital Games Research Association. 4, 171–207 (2019).
23. Vanduhe, V.Z., Nat, M., Hasan, H.F.: Continuance Intentions to Use Gamification for Training in Higher Education: Integrating the Technology Acceptance Model (TAM), Social Motivation, and Task Technology Fit (TTF). IEEE Access. 8, 21473–21484 (2020). https://doi.org/10.1109/ACCESS.2020.2966179.

24.Davis, M.: Examining and improving inclusive practice in institutional academic integrity policies, procedures, teaching and support. International Journal for Educational Integrity. 18, 1–20 (2022).
25.Khaleel, F.L., Ashaari, N.S., Wook, T.: The impact of gamification on students learning engagement. International Journal of Electrical and Computer Engineering. 10, 4965 (2020).
26.Schwarz, A.F., Huertas-Delgado, F.J., Cardon, G., DeSmet, A.: Design features associated with user engagement in digital games for healthy lifestyle promotion in youth: A systematic review of qualitative and quantitative studies. Games for Health Journal. 9, 150–163 (2020).
27.Hernik, J., Jaworska, E.: The effect of enjoyment on learning. In: INTED2018 proceedings. pp. 508–514. IATED (2018).
28.Birk, M.V., Atkins, C., Bowey, J.T., Mandryk, R.L.: Fostering intrinsic motivation through avatar identification in digital games. In: Proceedings of the 2016 CHI conference on human factors in computing systems. pp. 2982–2995 (2016).
29.Smiderle, R., Rigo, S.J., Marques, L.B., Peçanha de Miranda Coelho, J.A., Jaques, P.A.: The impact of gamification on students' learning, engagement and behavior based on their personality traits. Smart Learning Environments. 7, 1–11 (2020).
30.Metzger, E.C., Lubin, L., Patten, R.T., Whyte, J.: Applied gamification: Creating reward systems for organizational professional development. Foundation of Digital Badges and Micro-Credentials: Demonstrating and Recognizing Knowledge and Competencies. 457–466 (2016).
31.Saleem, A.N., Noori, N.M., Ozdamli, F.: Gamification applications in E-learning: A literature review. Technology, Knowledge and Learning. 27, 139–159 (2022).
32.Boddy, C.R.:"Sample size for qualitative research", Qualitative Market Research.19, 426-432. (2016).