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THE IMPACT OF GAMIFICATION ON STUDENT LEARNING PROCESSES IN TECHNICAL EDUCATION: A QUALITATIVE EXPLORATION IN BLENDED LEARNING

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ABSTRACT

Objective: This research aims to assess the impact of gamification in engineering education in a blended learning environment. It focuses on increasing students' motivation, engagement, understanding of technical concepts, and development of social and soft skills. The research also explores the role of technology in supporting gamification and identifies challenges in its implementation.

Research Design & Methods: This research uses a qualitative approach based on literature analysis and case studies of previous studies. Gamification elements, such as points, leader boards, challenges and rewards, are integrated into a technology-supported blended learning environment such as an ERP simulator and interactive platform. Data was analyzed to evaluate the impact of gamification on students' learning outcomes and social skills development.

Findings: This research uses a qualitative approach with literature analysis and case studies. Gamification elements such as points, leader boards, challenges and rewards are integrated into technology-supported blended learning, such as ERP simulators and interactive platforms, to evaluate their impact on learning outcomes.

Implications & Recommendations: Successful gamification in engineering education requires adaptive and flexible design to ensure game elements not only increase motivation but also remain focused on deep academic goals. It is recommended that educators and learning developers pay attention to students' different learning styles and avoid overusing competitive elements.

Contribution & Value Added: This research shows how gamification supports engineering learning in blended learning, emphasizing the important role of technology and the challenges of its implementation. The findings offer adaptive design solutions to improve learning effectiveness.

Keywords: Gamification, Technology, Student Engagement, Soft Skills.

JEL codes: I21, O33

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INTRODUCTION

Blended learning (BL), a combination of online and face-to-face instruction, has become a key strategy in modern educational technology. However, its effectiveness depends on overcoming challenges related to student motivation and engagement. In Blended learning (BL) has emerged as a popular strategy in the rapidly changing field of educational technology, which combines online and face-to-face instruction with ease (Hill & Smith, 2023). However, while BL offers a lot of potential in creating a dynamic and adaptive learning environment, its implementation also faces certain challenges. One of the main problems often encountered in BL design is reduced student

attention during the learning process, which is often caused by a lack of interaction or less engaging learning dynamics (Khaldi et al., 2023). Loss of motivation is another critical issue that can reduce the effectiveness of blended learning, as unmotivated students tend to be less engaged and participate less in learning activities. Thus, the successful implementation of blended learning is highly dependent on educators' ability to design an engaging and interactive curriculum, which is able to facilitate active engagement and maintain students' interest throughout the learning process (Zhang & Huang, 2024). In the context of blended learning, where students often face challenges in maintaining engagement and motivation, gamification is seen as a potential solution (Sailer et al., 2017). Recent systematic research highlights the importance of implementing gamification in online learning environments as an attempt to increase student participation and engagement. Game elements integrated into online learning provide opportunities for students to be more actively involved in the learning process, while the competition and reward aspects can motivate them to achieve better results. Thus, gamification can play an important role in addressing the challenges in blended learning, especially in terms of increasing student engagement in online learning platforms (Lam et al., 2018).

Technology has revolutionised education in recent decades, especially with the increasing use of gamification elements in learning (Moseikina et al., 2022). Gamification, which refers to the application of game elements such as points, badges, leaderboards and challenges in a non-game context, has been applied in many disciplines to improve student motivation, engagement and learning outcomes (Jayalath & Esichaikul, 2022). In engineering education, where learning challenges are complex and theoretical, gamification is becoming increasingly relevant as it has the potential to make the learning process more engaging, interactive and student-centred. The application of gamification, particularly in the context of blended learning, has shown a positive impact on student learning, which includes increased motivation, engagement and understanding of complex concepts (Samah et al., 2022). Engineering education often involves highly technical and complex subjects, such as maths, physics and information technology. A big challenge faced by instructors is keeping students engaged in material that may feel abstract and difficult to understand. Gamification, with its fun and challenging elements, can change the learning atmosphere to be more enjoyable and motivate students to continue engaging in the learning process (Buckley & Doyle, 2016). For example, research conducted by Luckemeyer (2015) showed that the application of a gamified virtual 3D environment for programming learning at university can reduce dropout rates and increase student engagement in difficult programming modules.

The gamification system not only involves challenges and rewards, but also encourages healthy competition among students (Saleem et al., 2022). Elements such as leaderboards, points and badges directly reward students for their achievements, which can increase their intrinsic motivation to achieve more (Strmečki et al., 2015). Implementing gamification in a blended learning environment can increase student engagement in higher education as students feel more valued and motivated to actively participate in their learning (Jaipal-Jamani & Figg, 2018). Blended learning is an approach that combines face-to-face learning with online learning methods. This approach offers flexibility for students to learn independently through online materials, while still benefiting from direct interaction with the instructor in the classroom (Müller et al., 2023). In the context of engineering education, where material is often complex and requires deep understanding, blended learning allows students to revisit difficult concepts and gain access to additional learning resources as needed (Shirokolobova, 2022). Gamification enriches the blended learning experience by providing challenges and rewards that can encourage students to interact more frequently with online learning materials. Research conducted by Samah et al., (2022) showed that by incorporating gamification elements in blended learning courses in TVET (Vocational and Technical Education and Training), student engagement can be significantly increased in both online and face-to-face activities. Students feel more motivated to complete assigned tasks due to game elements such as inter-group competitions and achievement rewards (Samah and Ismail, 2021). While gamification offers many benefits, there are some challenges that must be considered in its implementation. One of the main challenges is the possibility of students being so focussed on the elements of the game, so that the main purpose of learning can be sidelined. While gamification can reduce the stress associated with using technology in online learning, if not designed well, the game elements can

distract students from the main purpose of learning (Fajri et al., 2021). In addition, not all students respond to gamification in the same way. Individual preferences for game elements may vary. Therefore, it is important for educators to design gamification with the flexibility to allow students to choose the way that best suits their learning style.

This study explores the qualitative impact of gamification on student learning within a blended learning framework, with a particular focus on technical education where student engagement and motivation are crucial. In technical education, where learning often involves complex and applied concepts, gamification can be an effective tool to increase engagement and support student understanding (Kho et al., 2022). Elements such as challenges, rewards, points and leaderboards create an interactive learning environment and encourage intrinsic motivation, so students are more motivated to actively participate in learning activities (Sailer et al., 2017). Research shows that the integration of game elements in blended learning not only significantly increases student engagement but also strengthens their sense of achievement and satisfaction with the learning process (Lam et al., 2018). The implementation of gamification is not without challenges. One of the main issues is the potential for students to focus too much on game elements such as points or leaderboards, so that the main learning objectives can be overlooked. When students are more interested in 'winning the game' than understanding the material, learning effectiveness can be significantly reduced (Fajri et al., 2021). Unbalanced gamification design can distract students from developing their technical competence. Therefore, it is important for educators to design gamification elements that are not only engaging, but also relevant to the learning objectives (Kho et al., 2022).

In addition, not all students respond to game elements in the same way. Samah et al., (2022) showed that students with different learning styles have varying preferences for gamification elements. Some students may be more motivated by competitive rewards, while others are comfortable with individual challenges that focus more on personal learning. Therefore, it is important to design a gamification system that is flexible and allows students to choose the elements that best suit their learning style. This is supported by Hassan et al., (2021) which highlights the importance of adaptive design in gamification, such as providing real-time feedback and customisable difficulty levels, to ensure optimal learning outcomes. Gamification in blended learning offers a great opportunity to increase student motivation and engagement in engineering education. However, successful implementation is highly dependent on thoughtful and flexible design, taking into account differences in student learning styles and ensuring that game elements do not distract from the main learning objectives. This strategy can help students stay focused on understanding the technical material, while remaining engaged and motivated through integrated game elements.

LITERATURE REVIEW

Gamification in Education

The use of gamification in education has grown rapidly in recent decades and is increasingly accepted as a method to improve student engagement, motivation, and performance at various levels of education (Hellín et al., 2023). Gamification, which refers to the application of game elements such as points, badges and leaderboards in a non-game context, is recognised as an effective approach to learning, particularly in the field of technical education (Dahalan et al., 2024). The field of engineering, with its complex and often abstract nature, is in dire need of methods that can keep students engaged and motivated in the learning process. Gamification in the context of blended learning has proven to be a potential strategy to address such challenges, offering a more dynamic and flexible approach to teaching. This research aims to review the research that has been conducted on the impact of gamification in the context of blended learning in technical education, and identify both the positive outcomes and challenges faced. Gamification in an educational context involves the use of game elements designed to increase student engagement in a more fun and interactive way (Pardim et al., 2023). Elements such as rewards (badges, points), healthy competition (leaderboards), as well as challenges, are implemented in learning scenarios to motivate students to achieve specific learning objectives (Dambic et al., 2021). The concept has been

used in various fields of education, including social sciences, business, and engineering. Gamification as the use of game elements in non-game activities to influence individual behaviour and motivatio (Deterding et al., 2011). In education, it is applied to reinforce learning and make the learning process more interesting for students (Deterding et al., 2011).

Study conducted by Jayalath & Esichaikul (2022) in the field of technical vocational education showed that the use of gamification elements in blended learning significantly increased student motivation and engagement. Point systems, badges, as well as leaderboards, were utilised to create healthy competition among students, which resulted in an improvement in their academic performance. These elements also allow students to interact more frequently with the online course material, which in turn improves their understanding of difficult material (Jayalath & Esichaikul, 2022). Gamification in education signifies the integration of game design elements into teaching activities that are not inherently game-related. This approach differs from game-based learning, where the main focus is on engaging learners in games to acquire knowledge. Gamification introduces game dynamics into non-game-related environments to enrich the learning experience (Alsawaier, 2018). With the development of technology, gamification is becoming increasingly prevalent in educational frameworks, aiming to increase student engagement, motivation and interactivity (Oliveira et al., 2023). Empirical evidence supports that gamification can effectively address issues such as lack of motivation and frustration in educational contexts (Zainuddin et al., 2020). Components such as levels and leaderboards have been successful as external motivators, encouraging a competitive spirit among learners (Mekler et al., 2017). In addition, research shows that gamification can have a lasting effect on student participation, fostering beneficial learning behaviours (Alsawaier, 2018). Despite these positive aspects, some scientific studies have provided a more nuanced view, suggesting that gamification does not unilaterally improve academic outcomes. These mixed results invite deeper investigation into the conditions under which gamification can truly enhance the educational experience. Based on these findings, recent gamification designs have increasingly emphasised personalisation, taking into account the unique characteristics, needs and preferences of each student. Research has explored customising gamification frameworks to suit diverse student profiles, learning styles, pedagogical approaches and knowledge structures.

Blended Learning: Flexibility and Relevance in Education

Blended learning is a learning model that combines face-to-face learning with online learning elements (Buhl-Wiggers et al., 2023). The hybrid approach combines the effectiveness of classroom and socialisation with the technological benefits of online modules, offering an attractive alternative to conventional teaching models (Mourtzis et al., 2023). This approach has identified significant improvements in academic performance due to the efficiency, flexibility, and capacity of blended learning (Ayob et al., 2023). This approach also facilitates increased interaction between staff and students, encourages active engagement, and provides opportunities for continuous improvement (Efendi & Sholeh, 2023). This model has become an increasingly popular approach in modern education, both at primary, secondary and tertiary levels. Along with the development of information and communication technology, blended learning offers flexibility for students to learn anytime and anywhere, and provides various tools and platforms to support more interactive and effective learning (Bizami et al., 2023). Despite these advantages, blended learning is not without challenges, especially for students, teachers, and educational institutions in its implementation. Boelens et al., (2017) highlighted that students often face self-regulation challenges, including poor time management and procrastination. This literature review discusses the relevance and benefits of blended learning in education, particularly in terms of flexibility and quality of learning. Blended learning is a combination of traditional classroom teaching methods and online learning that allows students to access learning materials online (Ali et al., 2023). Blended learning as an education system that combines face-to-face interaction with the utilisation of digital technology, thus creating a more dynamic and flexible learning experience (Littlejohn & Pegler, 2007). Blended learning integrates online components, such as learning videos, online discussions and interactive quizzes, with face-to-face activities that focus more on in-depth discussions, collaboration and practice.

This learning model has great flexibility, especially as it allows students to access materials as they need them. Students are able to learn anytime and anywhere, which makes it highly relevant in today's digital age. Students can utilise time outside of class to study independently, re-watch learning materials, or use various additional resources available. In addition to flexibility, blended learning allows students to take more responsibility for their own learning, as they have more opportunities to self-learn and utilise various resources available online. Blended learning provides a balance between self-directed online activities and in-class interaction, which supports the development of students' cognitive knowledge and social skills (Hrastinski, 2019). Samah et al., (2022) found that in technical and vocational vocational education, gamified blended learning showed better results in terms of student engagement and motivation. The study involved two groups of students: a control group learning without gamification elements, and an experimental group learning with gamification elements. The results showed that students in the group using gamification elements had better learning outcomes and were more actively engaged in learning activities. Other research by (Luckemeyer, 2015) highlighted the benefits of using a gamified 3D virtual learning environment in teaching programming at university. The system helped to reduce dropout rates and increase student engagement in difficult programming modules. Gamification elements such as simulations, problem-based challenges, and collecting points for task completion, were shown to increase student participation and strengthen their understanding of complex programming material.

Gamification on Student Engagement and Motivation

Gamification offers an effective approach to increasing student motivation and engagement, especially in fields that are often perceived as complex, such as technical education (Gamarra et al., 2022). Technical learning, such as programming, maths and other engineering sciences, often requires a deep understanding of abstract concepts . Game elements, such as challenges, rewards, and competition, make this difficult material more interesting and motivate students to stay engaged in the learning process. Research by Dambic et al., (2021) shows that the implementation of gamification in programming learning helps students stay motivated even though the material taught is often considered difficult by many students. Programming often requires a strong technical understanding and logic, which can be overwhelming for students. However, by introducing gamification elements, such as challenges to be completed and rewards given after each task, students are more encouraged to try to understand the material despite its difficulty. This research shows that students who learn using a gamification approach are not only more motivated but also show improvements in their learning outcomes compared to students who do not use gamification.

One of the key elements that contributes to increased motivation is the rewards that are given after students have successfully completed a specific task (Mekler et al., 2017). These rewards can be points, badges, or even rankings on the scoreboard, which creates a sense of achievement and healthy competition among students (Richter et al., 2015). In self-determination theory, it states that students' intrinsic motivation can be enhanced when their basic psychological needs, such as autonomy, competence, and social connection, are met. Gamification fulfils these needs by giving students the autonomy to complete challenges in their own way, rewarding them for their achievements, and allowing them to compete or cooperate with their peers. Furthermore, gamification increases student engagement by creating a more interactive and dynamic learning environment. In engineering courses, where team collaboration is often an integral part of the learning process, gamification plays an important role in encouraging co-operation among students. Healthy team competition encourages students to work together in solving technical problems and solving challenges provided by the instructor, which ultimately improves overall learning outcomes (Sailer & Sailer, 2021).

In addition to increasing social engagement, gamification also motivates students to more actively participate in class activities (Chans & Castro, 2021). Students are no longer just passive recipients of information, but they are encouraged to actively contribute to discussions and solve challenges given (Purnamasari et al., 2024). This happens because the game elements provide opportunities for students to feel a sense of achievement directly, through the rewards given after

each task is completed, as well as through the progress that can be seen visually on the leaderboard. This sense of achievement motivates students to continue learning and strive for higher learning goals (Sailer & Sailer, 2021). Overall, gamification makes a significant contribution to increasing student engagement and motivation in engineering education. With engaging challenges and motivating rewards, gamification helps students stay engaged in learning even when the material is difficult. In addition, gamification creates a more interactive and dynamic classroom atmosphere, which supports the achievement of better academic results and enhances the overall learning experience.

Challenges of Gamification Methods in Engineering Education

The application of gamification in technical education is not without its challenges. One of the main challenges identified in the literature is how to ensure that the game elements support and do not distract from the main learning objectives (Saleem et al., 2022). When gamification is applied excessively or unbalanced, it has the potential to disrupt students' focus on achieving academic goals (John et al., 2023). Therefore, designing an effective gamification system requires a careful approach to ensure that the game elements encourage meaningful engagement without compromising the quality of learning (Adams & Du Preez, 2022). A key benefit of gamification in online education is its potential to reduce technology stress experienced by students, often referred to as technostress (Nascimento et al., 2024). Technostress refers to the anxiety and pressure experienced by individuals when they have to adapt to the use of new technology in an online learning context (Khlaif et al., 2023). Game elements, such as challenges, rewards and competition, can create a more engaging and interactive atmosphere, thereby reducing boredom and fatigue often associated with static online learning environments. However, although gamification has the potential to reduce technostress, there is a risk that if game elements dominate the learning process too much (Yang & Li, 2021). This is where students can lose focus on their primary goal - understanding and mastering complex technical material.

Poor gamification design or overly orientated towards game elements risks distracting students from academic material (Adams & Du Preez, 2022). For example, if awards or points are the main goal, students may be more motivated to 'win the game' than to understand the material being taught. Gamification should serve as a tool that enriches the learning process, not just entertainment (Sanchez et al., 2020). Therefore, instructors need to ensure that any game elements implemented are designed to support the learning objectives and not create distractions or confusion among students (Alzahrani & Alhalafawy, 2023). Another challenge in implementing gamification is the difference in student response to game elements implemented in the learning environment. Note that not all students respond to gamification in the same way. Students with different learning styles may have different preferences for the various game elements offered (Hassan et al., 2021). In the context of gamification, this means that instructors should consider how game elements can be modified or customised for different types of students. For example, students who are less motivated by competition may benefit more from game elements that encourage collaboration or practical simulation. Samah & Ismail (2021) emphasise the importance of implementing more personalised gamification strategies to accommodate students' various learning styles. Without flexibility in design, gamification may cause some students to feel marginalised or unmotivated, ultimately reducing its effectiveness in increasing learning engagement and motivation (Samah & Ismail, 2021).

In addition, the implementation of technology that supports gamification can also be challenging, especially in countries or institutions with limited access to technology. The digital divide remains a significant issue, especially in developing countries where internet access is uneven and technological devices are not always available to all students. In less technologically supportive environments, the implementation of gamification can be less effective, and can even lead to frustration among students who do not have access to adequate infrastructure (Roemintoyo et al., 2023). Instructors need to ensure that the gamification design not only relies on sophisticated technology, but is also accessible to all students, regardless of any technological limitations they may encounter (Saleem et al., 2022). In general, while gamification offers great potential in engineering education, its success depends on the balance between game elements and learning

objectives, individual student responses to the strategies used, and the availability of a supportive technology infrastructure. By considering these challenges, educators can design and implement gamification more effectively, so that the benefits can be felt by all students, regardless of differences in learning styles or technological limitations.

METHODS

This research uses a qualitative method with a document analysis approach to integrate various previous research results related to the application of gamification in blended learning. The main data sources in this research are relevant journals and scientific articles that discuss gamification teaching methods and its impact on student motivation and learning outcomes. Document analysis was conducted to gain an in-depth understanding of how gamification elements are applied in learning and how it affects academic performance and student engagement. The main purpose of this analysis is to analyse the application of gamification teaching methods in the context of blended learning and evaluate the resulting learning outcomes, particularly in improving student motivation. In addition, this research also aims to identify feedback from students that provides an overview of the effectiveness of gamification in the learning process. This research follows the literature review method to determine the advantages and challenges of gamification applications in blended learning. The analysis of scholarly references on a particular subject is a literature review. It provides an outline of current understanding, so that relevant hypotheses, approaches, and research gaps can be created. A literature review includes selecting, assessing, and studying publications related to the research problem such as books, articles, and journals. A literature review is a perfect way to present previous literature. It allows the compilation of research results.

RESULT

Based on the analysis of the summarised studies, there is a strong consensus that the implementation of gamification in blended learning in technical education has a significant positive impact on student motivation, engagement and learning outcomes. Gamification elements such as points, leaderboards, challenges and rewards are proven to be effective in encouraging students to actively participate in learning as well as increasing their intrinsic motivation. The research conducted by Shirokolobova (2022), Villavicencio Pazmiño et al., (2021), and Farooq et al., (2022) indicates that through a level and challenge-based system, students' motivation can be significantly enhanced, providing them with achievable short-term goals and generating a sense of achievement that increases their engagement in learning.

Table 1 Recent studies on gamification elements in blended learning

Authors	Aims of The Study	Results	Gamification Elements
Shirokolobova, (2022)	Gamification in blended learning for technical education enhances student motivation and soft skills development through a structured, level-based system integrated into electronic courses on the LMS Moodle platform.	a. Developed level-based gamification system for technical and humanitarian subjects. b. Increased student motivation and evaluated soft skills in blended learning.	a. Game mechanics in non-game contexts enhance engagement. b. Involves user experience through game-like elements.
Villavicencio Pazmiño et al., (2021)	Gamification can enhance blended learning in technical education by increasing student motivation, engagement, and meaningful learning	a. Gamification improves electronics learning in technical high school students. b. Statistical analysis supports gamification	a. Motivation strategies and meeting challenges. b. Rewards and technological tools with gamified approach.

Authors	Aims of The Study	Results	Gamification Elements
	through challenges, rewards, and the integration of technological tools.	as a methodological resources.	
Farooq et al., (2022)	Gamification enhances blended learning in technical education by increasing student engagement, motivation, and interaction, ultimately improving skill development and learning satisfaction in project management courses.	a. The paper examines the advantages of combining microlearning and gamification in teaching software project management concepts. b. The paper aims to understand how microlearning and gamification aid computer science students in comprehending and expanding their knowledge of project management-related topics.	a. Rewards like points, scores, and levels motivate students. b. Game scenarios should cover all knowledge areas effectively.
Kho et al., (2022)	Gamification enhances engagement in blended learning for technical education by integrating interactive elements, competition, and rewards, fostering motivation and improving understanding of complex concepts among students.	a. Positive results for gamification approach in online learning b. Improved engagement and enjoyment for engineering students	a. Narrative story and interactive map for engagement. b. Students' rank and video guide for learning support.
Tan & Hew, (2016)	The study highlights that meaningful gamification can enhance student engagement and affective outcomes in blended learning, though its impact on cognitive learning remains inconclusive in technical education contexts.	a. Experimental group showed higher engagement in discussion forums. b. Quality of group artefacts was significantly better in experimental group.	a. Points, badges, and leader boards are key elements. b. Activities based on self-determination theory enhance engagement.
Salas Rivas et al., (2022)	Gamification in blended learning enhances engagement, fosters competitiveness, and improves problem-solving skills, effectively integrating theory with practical application through interactive simulations and immersive technologies.	a. Significant increase in student learning with ERP simulator. b. Improved academic performance in industrial engineering topics.	a. Prizes, competition, teamwork, and scoring tables enhance engagement. b. Game challenges and objectives promote active learning and fun.

Authors	Aims of The Study	Results	Gamification Elements
Bouchrika et al., (2021)	How Gamified may specifically affect student behavior and e-learning technology interactive content.	Gamification may be regarded as a useful method to enable instructional programs to be implemented and improve its interactivity and involvement.	Badges, leader boards, and Scores
de-Marcos et al., (2016)	How well-developed education and social networking strategies compare with more innovative methods in terms of learning success in undergraduate school.	All investigational environments have an essential effect on learning achievement. Social gamification has produced more significant outcomes in terms of learning output through different assessment products.	Leaderboards, challenges, narrative, levels, trophies, points, badges.
Hassan et al., (2021)	The aim is to increase pupils' success, their inspiration, and their rate of completion using customized elements focused on the types of students' learning.	Accordingly, adaptive gamified components and chosen tasks may dramatically increase influences such as encouragement, end of the course, participation, and engagement in the electronic learning program.	Feedback, levels, leaderboards, points, badges, and goals.
Farreras Esclusa et al., (2022)	The paper distinguishes gamification from game-based learning, emphasizing that gamification enhances motivation through point systems, while blended learning can integrate both approaches for effective technical education.	a. The paper discusses the difference between gamification and game-based learning. b. The paper proposes using escape rooms as a game-based learning activity.	a. Points awarded for solving exercises in contests. b. Simple questionnaires monitored through tools like Socrative.
Garcia Villegas & Lemos Aguero, (2023)	The study primarily focuses on gamification in E-learning environments for programming, not specifically addressing blended learning in technical education.	a. Gamification is effective for learning programming in E-learning environments. b. The most used platforms, elements, languages, and focuses were identified.	a. Points motivate student interest in programming courses. b. Classification tables and insignias enhance motivation and interaction.
Shi et al., 2024)	The proposed gamification framework enhances blended learning in technical education by integrating game elements into course design, promoting exploratory learning, and motivating student engagement through quests and rewards.	a. Gamification framework enhances exploratory learning in STEM courses. b. Three case studies demonstrate feasibility and student feedback analysis.	a. Quests, virtual currency, virtual goods, store, rules, leaderboards. b. Mechanics, dynamics, and components drive gamification engagement.

Authors	Aims of The Study	Results	Gamification Elements
Aris Triwahyu Febriansah et al., (2024)	Gamification in blended learning for technical education enhances student engagement and motivation, promoting active participation and skill development through interactive elements like points, leaderboards, and challenges.	a. Increased use of gamification during Covid-19 pandemic. b. Higher education utilizes gamification the most in learning activities.	a. Points, leaderboards, rewards, levels, narratives, badges. b. Enhance motivation, engagement, and learning experience.
Husnawati & Carina, (2023)	The paper focuses on gamification in primary education, specifically using Kahoot, and does not address its application in blended learning for technical education.	a. Kahoot gamification improves student engagement, motivation, learning outcomes, and retention. b. Gamification can be used in traditional, online, and blended learning settings.	a. Level systems, points, badges, leaderboards, and avatars. b. Enhances engagement and learning outcomes in education.

In addition to increased motivation, research results such as those reported by Kho et al., (2022) and (Tan & Hew (2016) highlights that gamification also contributes to improved learning outcomes. By using interactive elements such as narrative stories, simulations and video guides, gamification helps students better understand complex concepts in engineering education. The research Salas Rivas et al., (2022) added that gamification-based simulations improved students' academic performance in industrial engineering topics, showing a direct relationship between the use of game elements and improved academic outcomes. In addition, gamification not only contributes to cognitive learning outcomes, but also to the development of students' social skills or soft skills. Shirokolobova (2022) and Hassan et al., (2021) shows that by incorporating elements of competition and teamwork in a gamified environment, students are more encouraged to develop communication and co-operation skills. The development of these social skills is particularly important in the context of engineering education, where interpersonal skills are a key element required in the professional world.

However, while many studies report positive results, there are also challenges that need to be considered in the implementation of gamification. Some studies such as the one conducted by (de-Marcos et al., 2016) and Hassan et al., (2021) emphasises the importance of flexibility in gamification design. Gamification elements should be tailored to the student's learning type to ensure that gamification can create long-term and sustainable engagement (Oliveira et al., 2023). Adaptive design that includes responsive feedback and levels tailored to students' abilities plays an important role in enhancing the effectiveness of gamification across different learning contexts.

DISCUSSION

Improving Student Motivation Through Gamification Elements

Increasing student motivation through gamification elements has been a prominent topic in research on pedagogical innovation, particularly in the context of technical education and blended learning. Elements such as points, leaderboards, challenges and rewards are consistently reported to have a significant impact on student motivation. Gamification works by providing measurable short-term goals, providing rewards after each achievement, and establishing a competitive yet supportive environment. The research Shirokolobova (2022) who developed a level-based system in engineering and humanities subjects, found that students' motivation increased when they were given short-term goals through a structured level system. This suggests that success in completing

challenges provides a sense of achievement and motivates students to continue learning and strive to do better. One of the main reasons why gamification is able to increase motivation is because these elements serve as positive reinforcers (Mee et al., 2021). In the traditional education system, rewards are usually limited to test scores or final assessments. However, with gamification, rewards are given periodically after each successfully completed task or challenge. This not only makes the learning process more interactive and engaging, but also provides a constant motivational boost for students. Farooq et al., (2022) highlighted that rewards such as points, scores and levels have a significant impact on increasing student engagement and motivation in software project management learning. These elements create a structured reward system, where every small step in the learning process is rewarded, encouraging students to engage more with the material being taught.

Beyond point-based rewards and challenges, some studies have also shown that narrative elements in gamification can provide additional motivation by creating deeper emotional and cognitive engagement. Narrative stories combined with gamification provide relevant and engaging context for students, so they feel more motivated to complete the tasks and challenges provided. This proves that gamification is not only about competition, but also about providing an engaging and motivating learning experience (Kho et al., 2022). One of the challenges to overcome in implementing gamification is ensuring that these elements are utilised in a balanced method. Similarly, research de-Marcos et al., (2016) where too much focus on competition through leaderboards or challenges can cause stress among students who are less comfortable with the element of competition. Therefore, it is important to create a balance between point-based rewards and other elements, such as group work or collaboration, to ensure that all students remain motivated, without feeling pressurised by too intense competition. Overall, the evidence found in various studies suggests that gamification serves as a very effective tool in increasing student motivation, especially in the field of technical education and blended learning. Elements such as points, leaderboards and rewards not only provide a continuous motivational boost, but also increase students' cognitive engagement in the learning process. With a balanced and adaptive design, gamification can be used to create a more engaging and motivating learning experience for all types of students.

Increased Engagement and Understanding of Complex Concepts

Increased student engagement and understanding of complex concepts through gamification has been one of the most significant benefits of this method, especially in the context of engineering education which often involves complex and abstract material. Gamification elements such as competitions, interactive narratives, simulations and video-based guides have been shown to make difficult material more accessible and understandable to students. The combination of competition and interactive narrative elements provides additional motivation for engineering students to engage more in the online learning process. Interactive narratives allow students to emotionally connect with the learning material, which in turn increases their cognitive engagement in solving complex problems (Kho et al., 2022). The simulation element of gamification also plays an important role in improving students' understanding of complex engineering concepts. Salas Rivas et al., (2022) reported that gamification-based simulation, specifically the use of an ERP (Enterprise Resource Planning) simulator, not only increased student engagement, but also significantly improved their academic performance on industrial engineering topics. The use of simulation allows students to practice technical concepts in realistic situations, which helps them understand the application of theory in practice. It also provides room for students to make mistakes and learn from experience, which is an effective way to understand complex material (Salas Rivas et al., 2022). In addition, Farooq et al., (2022) in their research combined a micro learning approach with gamification in learning software project management. This approach breaks down complex material into small parts that are easier to understand, then combines them with gamification elements such as points, levels, and game scenarios. The results show that this strategy helps students master difficult project management concepts in a more efficient way. The gamification elements make students more interested in exploring complex topics and maintain their engagement throughout the learning process.

In addition to increasing engagement and understanding, gamification also facilitates self-directed learning, which is important in engineering education. Elements such as challenges, points, and rewards allow students to learn at their own pace, revisiting material they find difficult without the pressure of a rigid class schedule. Gamification not only motivates students to participate more actively in discussion forums, but also helps them maintain a better understanding of the material being taught. The experimental group that used gamification elements showed better learning outcomes and higher quality group artefacts compared to the control group that did not use gamification (Tan & Hew, 2016). However, it should be noted that the application of gamification in the learning of complex techniques should be done with caution. de-Marcos et al., (2016) warns that too much competition or time-based challenges can add pressure and stress on students, which can ultimately hinder their understanding of the material. Therefore, the design of gamification should be balanced, taking into account the different learning styles of students and making room for those who may not feel comfortable with high competitive pressure. Overall, gamification elements such as interactive narratives, game-based simulations, and video guides have proven to be effective in increasing student engagement and helping them understand complex concepts in engineering education. By combining these elements, gamification is able to transform difficult learning material into a more enjoyable, interactive, and easy-to-understand experience. A good implementation of gamification can also reinforce self-directed learning, giving students the flexibility to tackle more difficult challenges at their own pace, while still being rewarded for their efforts.

Social and Soft Skills Development

The development of social skills and soft skills through gamification is one of the significant contributions in addition to its positive impact on cognitive learning outcomes (Nurtanto et al., 2021). In the context of engineering education, which often focuses on technical and theoretical aspects, the development of interpersonal skills such as communication, teamwork and collaboration is crucial (Van den Beemt et al., 2020). Gamification elements, especially those involving competition and teamwork, assist students in developing interpersonal skills (Shirokolobova, 2022). Healthy competition encourages students to interact with each other productively, while teamwork allows them to practice collaborating to complete a task or challenge. Through these scenarios, students not only focus on individual goals, but also learn how to communicate effectively and work together to achieve a common goal, skills that are crucial in the world of engineering work. In addition, gamification elements can be designed to suit individual student abilities. Hassan et al., (2021) shows that adaptive gamification elements, such as immediate feedback and customised levels, can increase social engagement and cooperation in online learning environments. Prompt and relevant feedback allows students to recognise areas where they need to improve, while customised levels help keep all students motivated, regardless of ability differences. It also creates an inclusive environment, where every student, both high achievers and those who need more help, can contribute and learn collaboratively. Gamification, with the right design, not only increases students' cognitive engagement, but also serves as a powerful tool for developing soft skills that are highly relevant to the modern world of work (Shi et al., 2024). Emphasising healthy competition, teamwork and communication through gamification elements, engineering students get the opportunity to hone the social skills required in a professional environment, strengthening their ability to work effectively in teams in the real workplace (Shirokolobova, 2022).

Challenges in Gamification Implementation

The challenges in implementing gamification, while recognised as effective in increasing student motivation and engagement, are also an important topic for educators and learning system designers to address. One of the main challenges that often arises is ensuring that the gamification design is flexible and adaptive, according to each student's learning style and preferences. de-Marcos et al., (2016) and Hassan et al., (2021) highlight the importance of tailoring gamification elements to the individual needs of students. This means that not all students respond well to elements such as competition, point-based rewards or leaderboards. For some students, the pressure to compete with their peers in an overly competitive context can create anxiety or

discomfort, which can reduce their motivation and academic performance (de-Marcos et al., 2016). In a gamification environment that is too competition-orientated, students may focus more on the game aspects-such as earning points or ranking-rather than on a deeper understanding of the material. This creates a risk that students will attempt to 'win the game' without actually learning. Therefore, it is important to allow flexibility in the design of gamification so that these elements are not just about competition, but also provide different ways for students to participate and feel motivated. For example, some students may favour team-based challenges or collaborative projects, where they can contribute to a group without high competitive pressure. In this case responsive feedback and levels tailored to students' abilities can help overcome these challenges, providing a more inclusive experience for all types of students (Hassan et al., 2021) .

Another challenge often encountered is the difficulty in maintaining a balance between gaming elements and academic objectives. In some cases, inappropriate implementation of gamification elements can divert students' focus from deeper academic learning. When gamification places too much emphasis on game elements, such as instant rewards or intense competition, key academic objectives can be marginalised. Therefore, it is important to design a balanced gamification system where the game elements still support deeper conceptual and cognitive understanding (de-Marcos et al., 2016). In addition, there are challenges in terms of providing quality feedback in real-time. Students need to receive relevant, specific and useful feedback to stay motivated and aware of their progress. Slow or unclear feedback can make students lose interest or be unsure of their performance. Successful gamification requires a system that can provide timely and relevant feedback, which not only provides information about rank or points, but also about how students can improve their understanding (Garcia Villegas & Lemos Aguero, 2023). Overall, while gamification offers a lot of potential in education, these challenges show that its implementation requires careful planning and adaptive design in order to meet the needs of different types of students and stay focused on achieving deeper academic goals.

The Role of Technology in Gamification

The role of technology in supporting gamification in online learning environments is a key factor in creating an interactive, engaging and efficient learning experience. Villavicencio Pazmiño et al., (2021) and Farreras Esclusa et al., (2022) highlights how the use of technological tools such as ERP simulators and interactive platforms such as Socrative can enrich the learning process by integrating game elements into online platforms. Technology not only facilitates the delivery of material, but also serves as a medium that reinforces student engagement in learning through the use of engaging gamification elements, such as challenges, rewards, and game-based simulations. The use of technology in gamification allows students to actively engage with the learning material. The use of ERP simulator helps industry students practise resource management theories in a realistic and hands-on way (Farreras Esclusa et al., 2022). These simulations provide a practical experience close to the real world, where students can make decisions and see their impact first-hand in a simulated environment. Such technology provides an opportunity for students to apply theoretical concepts into a practical context, so that they are not only passively learning, but also actively solving problems relevant to their future careers (Farreras Esclusa et al., 2022). Interactive platforms such as Socrative mentioned by Villavicencio Pazmiño et al., (2021), make it possible to integrate game elements into quizzes and exercises that can be accessed online. Using this technology, teachers can provide immediate feedback to students, organise time-based challenges, as well as provide rewards directly after students complete tasks or exercises. This allows for a responsive and dynamic learning environment, where students are continuously motivated to actively participate in learning. Socrative also supports collaboration and healthy competition through setting up leaderboards that can show students' progress compared to their peers, encouraging higher engagement (Villavicencio Pazmiño et al., 2021). Technology not only acts as a delivery medium or a tool to facilitate gamification, but also enables personalisation and customisation of the learning experience according to students' needs. In the context of gamification implemented through online platforms, technology allows adaptation based on each student's learning abilities and preferences. This is in line with the findings of Hassan et al., (2021) who emphasised the importance of adaptive gamification elements, such as customised levels and immediate feedback, to provide an inclusive learning experience. Technology makes it easier to

implement flexible gamification designs, where students can progress through levels that suit their abilities, while receiving feedback that is relevant and supports their learning progression (Hassan et al., 2021).

The use of technology in gamification also enables the provision of learning environments that support distance learning and blended learning, where students can learn anytime and anywhere, without being limited to a physical classroom (Bouchrika et al., 2021). This is important in today's digital age, where flexibility and accessibility are key elements in education. Technology allows students to access interactive learning content, such as simulations, videos, and gamified quizzes, through their own devices, increasing their flexibility and engagement. Overall, technology plays a very important role in the development and implementation of gamification in online learning environments. By integrating technology in gamification, educators can create a more dynamic, interactive and adaptive learning experience, which not only supports the delivery of material, but also enriches student engagement, increases motivation and helps them understand the material more deeply. Technology allows gamification to truly become an effective and flexible learning tool in this modern era.

CONCLUSION

Gamification has proven to be a highly effective method of increasing student motivation, engagement and understanding, particularly in technical education and *blended learning*, with technology playing a central role in supporting its success. Game elements such as points, leaderboards, challenges and rewards provide ongoing motivation to students, allowing them to stay motivated and focused in the learning process, especially in tackling complex and abstract material. The use of technology, such as ERP simulators and interactive platforms like Socrative, enriches the learning experience by providing a simulated environment and interactive real-time feedback, allowing students to interact with the content more deeply and actively. These technologies also enable more flexible learning, providing opportunities for students to learn anytime and anywhere, supporting the delivery of material in *blended learning* scenarios. In addition to improving cognitive outcomes, gamification also plays an important role in the development of *soft skills* and social skills, such as communication and collaboration, through collaborative tasks and elements of healthy competition Shirokolobova (2022) and Hassan et al., (2021) shows that adaptive gamification elements enable students to work together and develop interpersonal skills that are highly relevant in the modern world of work. However, the implementation of gamification faces challenges, especially in terms of design, which must be flexible and adaptive to suit individual learning preferences. de-Marcos et al., (2016) warns that excessive competition can cause stress for some students, so gamification elements must be designed in a balanced way to remain relevant to academic goals without taking students' focus away from deep understanding. With the right design, gamification has great potential to enhance various aspects of learning in the context of technical education and blended learning.

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