Journal of Information Systems Engineering and Management
2025, 10(4)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Integration of Gamification-Based Learning into College Physics: Digital Applications and Strategies

[1]Dr. Enaz Mahmoud, [2]Dr. Rexon Taguines
[1]*Assistant Professor, Dept. of Mathematics, Science and Information and Communication Technology, Bahrain Teachers College, University of Bahrain*
[2]*Assistant Professor, Dept. of Mathematics, Science and Information and Communication Technology, Bahrain Teachers College, University of Bahrain*
Emails: [1]EnazMahmoud@outlook.com [2]RexonTaguines@outlook.com
Corresponding Author: Dr. Enaz Mahmoud
Corresponding Author Email: enazmahmoud2@gmail.com

ARTICLE INFO

Received: 15 Mar 2025

Revised: 10 Jul 2025

Accepted: 25 Jul 2025

ABSTRACT

In the recent decade, a vast majority of college students have used gamifications applications greatly while studying science, and particularly physics. Gamifications applications provide college students with interactive learning experience in different ways. Such entertaining practice requires the academic instructors to identify whether and how gamification applications affect teaching college physics courses. Therefore, the present study seeks to determine the influence of gamification viewed by college students on learning physics. It is informed by the descriptive research design that does not entail or require college students to participate in the procedures and steps, as data analysis, findings, and discussions of numerous related studies were carefully reviewed and examined by this study in an effort to narrow down to the potential effect. This study finds that university students use gamification applications in studying physics in several different manners, including: higher motivation and engagement, instant feedback and improvement tracking, mastery and retention, and personalized learning. It sets that gamification applications improve university performance in physics significantly by enhancing their problem solving, imagination, transferring knowledge, and developing new ideas in many different creative ways. It recommended well-planned practical applications of gamification applications. It illustrated their best approach to improving college students' skill at physics. It propounds and offers potential solutions on how to prevail over the available technical and academic limitations that permit college students to efficiently utilize gamification applications.

Keywords: Gamification, Student Engagement, Educational Platforms, Learning Outcomes, Motivation, Interactive Learning.

Introduction

Gamification in learning has made progress over the past several years, with a thrilling way of engaging learners and enhancing learning processes in most areas. In college physics, where implemented, gamified learning methods can advance learning intricate concepts to a better level, raise learner motivation, and make learning more interactive and enjoyable (KOMOLAFE, 2022). With the aid of digital resources and technologies, teachers can develop gamification strategies that cater to the demands of contemporary learners and introduce physics abstract concepts in easy-to-understand forms. Gamification is a process of transferring game design mechanisms, like points, levels, badges, and challenges, into non-game environments, including schools. The application of gamification in college physics can be understood in various ways (Al-Mutawah et al., 2018). Gamification refers to the use of game mechanics, such as the awarding of points, competition, game rules, or rewards, outside of games, such as in business or education. Gamification targets improving participation, engagement, and motivation through leveraging the same psychological elements that create games engaging (Roleda, 2018). It is typically provided as challenges that verify users, reward progress, and provide the sense of achievement (Welborn, 2023). Gamification in learning seeks to reimagine traditional learning by embracing elements such as leaderboards, badges, levels, and feedback loops with the aim of enhancing the students' participation and performance in learning. Physics is the science of the nature and behaviour of matter and energy. Physics is a field which seeks to explain the basic forces of the universe, such as gravity, electromagnetism, and

Journal of Information Systems Engineering and Management
2025, 10(4)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

the weak and strong nuclear forces. Physics is the examination of the macroscopic universe (e.g., planets and galaxies) and the examination of the microscopic universe (e.g., atoms and subatomic particles). It is based on experimental methods and mathematical formulation in creating the laws that describe how the world naturally operates (Mahmoud, 2009). Physics not only underpins all the other sciences but is also at the centre of the creation of new technologies and innovations that make up our everyday life.

Physics has traditionally been considered a hard subject with learners not grasping its theoretical and mathematical components. Gamification can prove useful to overcome such problems through the provision of instant feedback, rewards for progress, and breaking down hard subjects into simple units (Zourmpakis et al., 2024). Among the strongest gamification elements, including competition, collaboration, and sense of achievement, most strongly resonate with physics learning outcomes: critical thinking, problem-solving, and deep understanding of physical principles. Gamification of learning is intended to enhance students' motivation, engagement, and performance through more appealing and interactive learning processes (Mahmoud, 2014). If gamification were implemented for college physics, it would render students an active learner to their learning, stick to tough issues, and think about challenging concepts of physics in new and interesting manners. Gamification has the potential to revolutionize college physics courses by increasing participation, improving retention, and making the challenging material more engaging (Diaz & Estoque-Loñez, 2024). By the use of the enjoyment of games and the rigor of physics, students can be motivated to learn more about the subject and take more interest in their own education.

Benefits of the Integration of Gamification-Based Learning into College Physics

Gamification of college physics is a new learning solution that has numerous benefits to both learners and educators. By integrating game mechanics with learning material, gamification introduces greater fun and interactivity while learning (Alonso-Sánchez et al., 2025). Gamification also has an edge over entertainment values as it may lead to enhanced learning outcomes, greater understanding, as well as motivating learners in developing more comprehensive and interactive learning environments (Al-Mutawah et al., 2021). There are certain significant benefits of gamification-based learning incorporated into college physics that need to target them. Gamification is highly essential in improved student motivation and involvement. Gamification can transform the otherwise, even intimidating, physics content into a pleasurable process that encourages proactive involvement (Hung et al., 2015). Leverage of video game mechanics such as badges, points, levels, and rewards have a strongly positive impact on improved student participation. For a subject like physics, which can be theoretical or daunting for certain students, gamification provides the tangible, interactive experience. Instant reward and feedback, since college students are able to answer challenges and level up, they receive instant feedback, which consolidates learning and makes them wish to do more (Naldoza & Bilar, 2024). Healthy competition, as competition on the leaderboards or competition among their peers can thrill them and motivate them to work harder to master the subjects.

Gamification is also critical in enhanced retention of physics concepts. One of the primary advantages of gamification is greater information retention. Through normal lecture-style approaches, learners can passively absorb information, while gamified sessions require engagement, and hence the learning happens at a greater level, together with enhanced recall over the long term. Practice and repetition since gamification tends to include repeated practice via quizzes or challenges, which is crucial for the mastery of complex physics concepts. Such repetition is especially worthwhile on subjects like physics, wherein knowledge is incremental. Context learning also, because games have the nature of presenting context, thus enabling students to comprehend how principles of physics act in the physical world, making abstractions less abstract (Theodoropoulou et al., 2024). Gamification is significant in physics since it can improve problem-solving and critical thinking. The gamification learning environment will more than likely present students with problems and situations that require creativity of mind and problem-solving. This is useful in physics since students have to relate theoretical concepts to reality from motion to addressing challenges in energy conservation. Simulation-based problem-solving, such as physics simulations, such as used in programs such as PhET Interactive Simulations, allow for experimentation with variables and seeing how changing them affects outcome. These active exposures stimulate exploration, thinking, and hypothesis testing. Puzzles and problems, such as most physics-based computer games are puzzle-oriented, necessitate critical thinking, application of formulas, and reasoning through the solution, which fosters a problem-solving mindset (Mahmoud, 2023).

Gamification supports a growth mentality since it stimulates a growth mentality by making the students embrace challenges and learn from failure. Failure in traditional learning may be interpreted in a negative way, but in gamified

learning, failure is inherent in the learning process. By using the gamified material, the students are prompted to try new things, fail, and keep going without punishment. Trial and error, as the majority of physics-based video games or exercises allow students to fail and try once again. This type of repetitive process instils perseverance and allows students to learn that mastery is only accomplished by persistent practice and not quitting. Progression, as when students advance from level to level or test to test, they realize that they are improving, which reminds them that one can become better through effort (Al-Mutawah et al., 2019). Gamification is also an experience of learning that is adapted to the learner in that it can be structured to meet multiple learning styles and paces, offering a more personalized and adaptive learning experience. This is particularly important in classrooms with diversity, where students might have different levels of prior knowledge or learning styles. Adaptivity because the majority of gamification platforms react to the performance of the individual learner and adjust the level of difficulty in challenges based on how well they are performing. It allows the learner to control their own speed and responding to challenges in relation to their level of understanding at any moment. Choice and agency because gamification platforms tend to allow students to choose their own challenge, quests, or topics to work on. This choice stimulates discovery and makes learning more exciting and fun (Hung et al., 2015).

Gamification promotes collaboration and social learning. Gamification is sometimes linked with personal problems, but collaboration and team building can also be facilitated. Team games, collaborative problems, and peer review systems promote students to collaborate, share ideas, and learn from one another, and a sense of community is felt in the classroom. Team challenges, as physics-based games with teamwork, allow students to work together to solve problems by synthesizing their skills and knowledge. This collaboration not only enhances learning but also develops critical social skills such as cooperation and communication. Interaction among peers, as leaderboards or success in celebrating group achievement can enable collaborative learning or even creative competition. Students can share techniques, debate findings, and motivate each other to learn more (CHAIPIDECH et al., 2024). Gamification is the solution to increased motivation through rewards and appreciation. Gamification's use of rewards in the form of points, badges, and unlockable can be powerful drivers. Such rewards not only compensate students for achieving, but also encourage students to become owners of their learning. Badges and achievements: Awarding badges to students for mastering a subject or completing a difficult task provides them with physical reminders of accomplishments, which sustain motivation. Levelling up, as the students work through increasingly difficult levels in a game-like education, feel a sense of accomplishment and are spurred on to continue moving on to new, higher levels of knowledge (Pereira et al., 2024).

Instant feedback and continuous assessment are needed by gamification. Gamified learning systems often provide instant feedback, and therefore, students can see immediately how they are doing and where they should concentrate on making it better. This is a huge benefit compared to traditional assessment, which could provide feedback after the fact. Instant correction, such as in a gamified system, students can see the result of their actions immediately. When they make mistakes, they can correct it instantly and this makes learning better and misconceptions are addressed early. Constant evaluation as instead of having just sporadic exams, gamification allows constant evaluation in the shape of quizzes, challenges, and games. The constant feedback loop ensures students are on the right track and learning the material (Singh, 2025). Gamification helps make complicated concepts simpler. Physics involves many theoretical concepts that are possibly difficult to grasp for the students. Gamification offers a channel of breaking down such difficult concepts into playable, enjoyable moments. The abstraction of concepts into simulated or game-like interactive ways allows students to grasp how physics functions in actual life more efficiently. Interactive simulations, as available with tools like PhET, allow students to manipulate variables and immediately observe the outcome, which makes concepts like force, energy, and motion concrete. Story-based learning, as games that use storytelling are able to place physics concepts within context (e.g., space exploration, engineering issues), making it easier for students to understand how these concepts translate in everyday life (Mahmoud, 2009).

Gamification is also useful in learning physics as it enhances accessibility and inclusivity. Gamified learning can be more inclusive, allowing students with diverse learning needs the chance to interact with content that best suits them. Whether the students require additional time, learn better visually, or learn by practicing, gamification can modify itself to meet different learning abilities and styles. Several paths of learning, since gamification offers several paths of learning, from visual and interactive experiences to written content and discussion, so that students with different learning styles are able to excel. Accessible content, since most gamified platforms are made available to disabled students, with features such as voice commands, subtitles, and visual cues (Jiménez-Valverde et al., 2024). Gamification of university physics facilitates long-term motivational as well as engagement levels to higher levels of comprehension of difficult concepts.

Journal of Information Systems Engineering and Management
2025, 10(4)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Using game-like elements, learning may be transformed into a more interactive, individualized, and engaging process. Gamification not only simplifies learning and comprehending physics but also makes it possible to learn critical thinking, problem-solving, and collaboration skills necessary to excel at the subject and in life. Last but not least, gamification can indeed transform the nature of physics education and learning so that it becomes more effective, accessible, and enjoyable for everyone (Davis & Bellocchi, 2020).

Challenges and Solutions for the Integration of Gamification-Based Learning into College Physics

The addition of gamification in university physics can have the potential to revolutionize the learning process, and make it fun, interactive, and more engaging. Like any new innovation in learning, there are issues that need to be solved to enable its effective use. These are related to technology and pedagogy as well as accessibility and engagement of students. There are various key challenges of implementing gamification in college physics education and present potential solutions to each (AKSAY et al.). Infrastructural and technology problems, because gamified education college physics, in most cases, relies on advanced technology infrastructure, e.g., software programs, applications, and simulation facilities for simulations, virtual laboratories, and interactive game environments. These can prove to be difficult, particularly in schools that are poorly equipped with high-tech hardware. Additionally, not all students might have access to mandated devices or a stable internet connection, which can undermine the effectiveness of gamified learning. To overcome these constraints, schools ought to invest in mobile apps and cloud-based applications that do not require high-performance hardware (Alqarni & Alabdan, 2022). The majority of the physics simulation software like PhET or Algodoo are web-based and can be accessed via many different kinds of devices, hence being more accessible to a broader set of students. Additionally, instructors can design gamified activities that are low-tech accessible, such as printable sheets, card games, or class challenges that utilize minimal technology. For schools or colleges with sparse resources, teachers may also investigate open-source or free tools for offering equal opportunity to all learners (Al-Mutawah et al., 2022).

Technological and infrastructural barriers because gamified learning of college physics at times requires very sophisticated technical infrastructure, e.g., software, programs, and gadgets used in simulations, virtual labs, and interactive games. This may be a limitation, particularly where institutions have no considerable availability of cutting-edge high-tech technology. Additionally, not all the students may have the gadgets required or access to certain standards of internet connectivity, which may reduce the reach of gamified learning. In order to overcome these barriers, schools and universities can invest in cloud-based software and mobile apps that do not require high-performance hardware (Hung et al., 2015). Most simulation software used for physics, like PhET or Algodoo, is web-based and can be accessed from a range of devices, thus making them more accessible to a wide range of students. Besides, instructors can also design game-like activities compatible with low-technology environments in the form of print-out worksheets, card games, or class assignments that do not involve heavy technologies. For schools or colleges that are institutionally resource-constrained, the instructors can utilize open-source tools or free solutions to offer the same degree of accessibility to every student (Gaurina et al., 2025).

Time and resource constraints on teachers, because creating an overarching and effective gamified curriculum is time- and effort-intensive on the part of teachers. It takes a considerable amount of time to design learning activities using games, create virtual labs, and develop quizzes and integrate these pieces into the complete course curriculum. Additionally, some teachers lack technical proficiency or aptitude to integrate gamification in teaching. In order to get around this constraint, educators can collaborate with instructional designers or edtech specialists to design gamified learning activities (Al-Mutawah et al., 2021). Several learning platforms, like Kahoot! and Quizlet, have pre-made templates and contents that one can simply customize. With such tools, teachers are in a position to save time while still designing effective gamified learning activities. Also, professional development programs or workshops may be provided by colleges to their teachers so that they are accustomed to the tools and methods that are needed in gamification. This would create the capability among the teachers so that they could incorporate game-based learning easily within their classes (Mahmoud, 2015).

Student resistance and participation issues, as not all students will naturally embrace gamification as a pedagogical approach. Some will find it to be unnecessary or a distraction from the "serious" business of college physics. Students who are used to traditional lecture-hall learning will have difficulty making the transition to a more interactive, game-based model. Furthermore, gamified material is not automatically suitable for every learner as there are learners who will not have the natural interest in gamified material, especially when challenge or reward does not interest their

Research Article

learning requirements or educational goals. In order to eliminate learner resistance, instructors must obviously communicate why and why gamification is worth (Richter & Kickmeier-Rust, 2025). Gamified learning should never be considered a play tool itself but a reward mode of confirming complex physics concepts. Instructors can relate game activities to learning goals and show how they are a part of the process of learning difficult material. To make gamified activities interesting, they must be designed with student interest in mind. For example, physics games can use real-world scenarios (e.g., space exploration, car accidents, green energy shortages) to demonstrate the use of physics in daily life. The students also need to have some freedom to do things their own way when engaging with gamified content, such as the freedom to choose which ones of these challenges to try and how they want to earn points or badges. It can allow for the provision of support for various learning styles. Instructors also need to instil a growth mindset by emphasizing how the effort involved in struggling with challenges and learning from error is part of the game. This can habituate students to value gamification as a means of learning and becoming proficient in physics concepts instead of incentives (Zakaria & Mahat, 2024). Gamification-based learning for college physics has numerous benefits but is accompanied by a set of related challenges as well. By transcending technological constraints, providing instructors with training and course materials, surmounting student motivation, providing learning value, developing sustainable assessments, and making it personalized, these challenges can be met. With proper planning, gamification can become a very real way of making learning physics more enjoyable, interactive, and successful (Beltozar-Clemente & Díaz-Vega, 2024).

Statement of the Problem

Gamification of learning environments has been among the most researched areas in the past decade due to the immense potential that it embodies towards provoking students' motivation, engagement, and learning (Diaz & Estoque-Loñez, 2024). Gamification has entered a very broad spectrum of fields around the world but its extension to physics education at a college level remains to be tapped (Carrillo et al., 2019). Physics, as an abstract and subtle subject, presents a unique type of challenge to the students as well as the teachers. Traditional teaching with a dominance of lectures and reading from textbooks is not able to cater to the diverse learning requirements of the students or achieve deep understanding in the subject. This is so because the students are unable to connect theoretical concepts of physics to real life, and they lose interest and become demotivated (Atsuwe & Vaava, 2022). In addition, the use of conventional methods may not be capable of leveraging the built-in motivational machinery available in games, like real-time feedback, reward, and interactive challenge. Students can thus have problems with some basic concepts like motion, conservation of energy, and electromagnetism, and this can have a deleterious impact on their performance and interest in the subject (KOMOLAFE, 2022; Mahmoud, 2023)

This study seeks to investigate the adoption of gamification-based learning methodologies in university-level physics education, more specifically with the help of computer programs. By examining in what ways and to what level gamification material and methodology, i.e., interactive simulations, quizzes, challenges, and incentives, can be incorporated into teaching physics, this research seeks to establish whether these can enhance the interest, knowledge, and scholarly performance of the students. In addition, the study will examine best practices in gamification application to bridge the gap between theory and practice in learning, and hence enhance the learning process for physics students at the college level. Hence, the current study aims to provide answers to the following three research questions:

1. How does the use of gamification-based learning mechanics affect student motivation and engagement in college physics courses?
2. What impact does computer-based gamification software, such as interactive quizzes and simulations, have on students' learning and retention of basic physics concepts?
3. What are effective strategies and best practices for the application of successful gamification to undergraduate physics instruction, and how do they influence students' learning outcomes?

Study Methodology

In the context of this study that investigated the incorporation of gamified-based learning in college physics with a specialization in the digital tools and strategies, the descriptive method was employed in reviewing and analysing systematically the literature and research that is available on incorporating gamification in physics learning. Its purpose is not to test new hypotheses or gather primary data from the participants but to compile and condense existing knowledge on the topic. Descriptive research methodology has been used in this research for several reasons. Emphasis

Research Article

on literature review, as the central purpose of this research is to analyse and review existing research, theories, and applications of gamification in college-level physics teaching. Since the study does not demand the gathering of new facts from respondents, the descriptive method is most appropriate for compiling and integrating the findings of previous studies. It helps in ascertaining trends, missing gaps, and the overall effectiveness of digital gamification tools in physics teaching. No primary data collection, as the current study has no participants or immediate experiments, a descriptive methodology is best suited to the summarization of secondary data, like available literature, articles, and studies. As there are no participants for the current study, descriptive analysis comes into prominence in place of experimental control or collection of firsthand empirical data. Placing current information in perspective because the descriptive study method enables the researcher to provide a comprehensive description of how gamification has been applied in physics teaching from published literature. With the historical context, previous outcomes, and increasing trends, the study will set a comprehensive picture of how e-gamification methods are being adopted and impact student engagement and learning. Best practices identification, in this manner, as through this, the study will be able to gather, categorize, and expound best practices and strategies from past research and physics education teaching innovations.

By published case studies, outcomes, and theoretical constructs, the researcher will be in a position to identify successful approaches to gamification in teaching physics. The identification of areas of gaps and opportunities, as descriptive studies also enable one to identify areas that need further research, or where there are gaps in the current knowledge. In this case, reviewing previous research will sketch the pitfalls or deficiencies of previous work in incorporating gamification in learning physics and provide a hypothesis for future investigation on this subject. The descriptive study design is appropriate for this study because it will allow for thorough reading of previous literature and insights gained from previous studies on the incorporation of gamification into university-level learning of physics. Since the current study does not involve participants or data collection, the descriptive approach helps in providing a vivid picture of the current scenario of gamification-based learning in physics and provides a foundation for extended study of its efficacy and application.

Results and Discussion

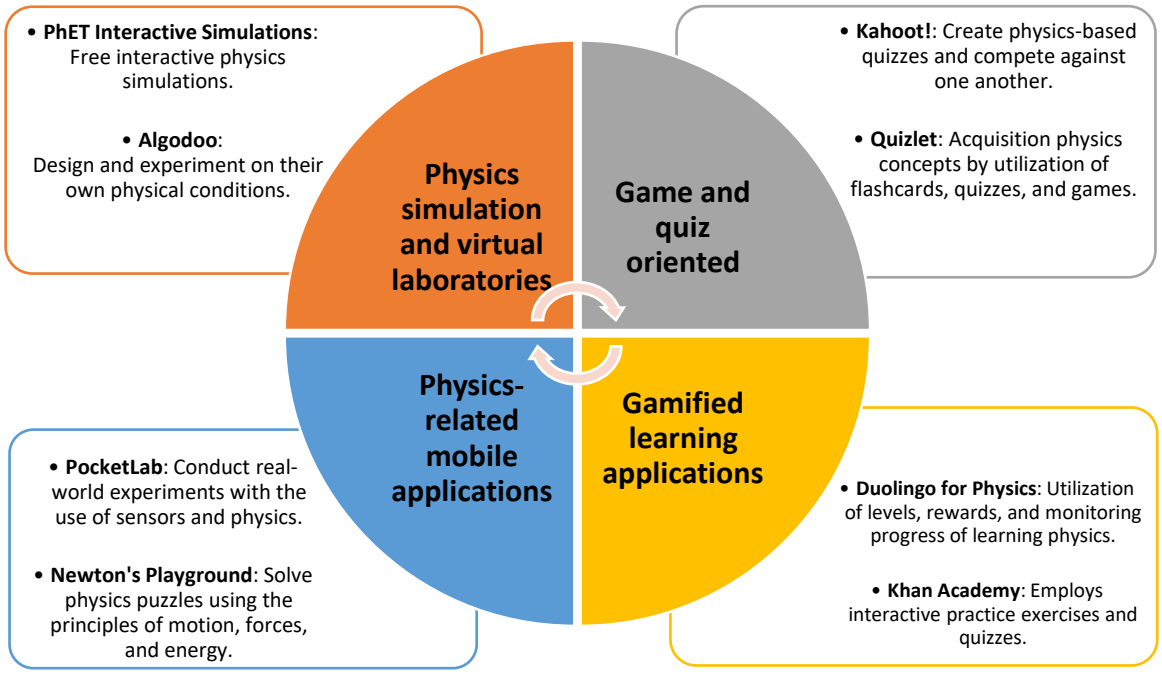
Some of the findings of this research are in favour of the strengths and weaknesses of gamified learning approaches. The potential of gamification to transform the learning of college physics, in terms of greater interactivity, engagement, and effectiveness, is, according to this research, true. It also shows that there is a need for proper integration and continuous adjustment of gamification methods to align them with pedagogical objectives and suit various students' requirements (Al-Mutawah et al., 2022). This study concluded that there are several benefits of gamification of college physics in terms of higher motivation and engagement through the use of game mechanics, students are more likely to remain motivated throughout the course. The dynamic and interactive nature of gamified learning keeps the students interested and engaged in the subject (Naldoza & Bilar, 2024). It found that gamification with instant feedback and improvement tracking offers instant feedback, which shows the students where they stand in the learning process. The instant feedback loop offers constant improvement and a clear path map for the students to progress on (Theodoropoulou et al., 2024).. It showed that more mastery and retention can be achieved since the repetitive nature of game learning ensures improved recall. Mastery of physics concepts is gained deeper through the performance of challenges by students, resulting in better long-term understanding (Mahmoud, 2023). It recognized that gamification can be employed to perform personalized learning in a manner that students can progress at their own rates, reacting to the individual learning rates of the learner. This is to prevent the students from being lagged behind or overwhelmed (Hung et al., 2015).

As appear in Figure1, this study found some useful applications and games that are helpful in integrating gamification into teaching college physics courses, such as: PhET Interactive Simulations, Algodoo, Kahoot!, Quizlet, PocketLab, Newton's Playground, Duolingo for Physics, and Khan Academy. It categorised them into different types based on their functional systems and procedures, including: physics simulation and virtual laboratories, game and quiz oriented, physics-related mobile applications, and gamified learning applications (CHAIPIDECH et al., 2024; Pereira et al., 2024; Singh, 2025)

Journal of Information Systems Engineering and Management
2025, 10(4)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Figure 1: Types of suggested gamification applications.



The research in this study reported that physics simulation and virtual laboratories, for example: PhET Interactive Simulations by the University of Colorado Boulder, PhET offers a series of free interactive physics simulations. The interactive simulations allow students to see abstract concepts such as motion, forces, energy, and electricity and hence understand abstract concepts with ease through the help of interactive experiments. With virtual labs, they can "level up" through challenges and experiments and be awarded points or badges on achievement (Jiménez-Valverde et al., 2024; Mahmoud, 2009). It found Algodoo as a physics simulation tool where the students are allowed to design and experiment on their own physical conditions. Through the process of variable trial with resultant immediate effects watched over, experience can be used by students in learning physics rules in a simulation game-like atmosphere (Davis & Bellocchi, 2020). It was game and quiz oriented, e.g., Kahoot!, as the well-known quiz website can be used to create physics-based quizzes where students answer instantly for scores. Kahoot gamified, where students compete against one another in a class environment, fosters active participation and is accessible to physics concepts (AKSAY et al.).

It discovered that Quizlet as an educational application can be used in a way to make the learning of significant physics concepts and vocabulary words easier for the students through the application of flashcards, quizzes, and games. The students are able to track their performance as they can earn badges and overcome challenges and become smarter on the topic (Al-Mutawah et al., 2022). This study provided a catalogue of physics-related mobile applications, which are the following: PocketLab app, as this app allows students to conduct real-world experiments with the use of sensors and physics probes plugged into their smartphone or tablet. They can record data, analyse results, and receive immediate feedback, hence an interactive and engaging learning content for physics principles through gamified exercises. It found that Newton's Playground is an application game where students solve physics problems by applying the principles of motion, forces, and energy. Through levels where the students advance, they introduce them to new challenges that challenge them to think for a long while about the physical laws (Gaurina et al., 2025). This study validated that gamified learning applications, e.g.,: Duolingo for Physics, as although Duolingo is more language-focused, the concept of gamification in it, i.e., application of levels, rewards, and monitoring progress, can be applied to physics (Al-Mutawah et al., 2021). These websites can apply these concepts to try to build physics modules to be completed by students whenever they want. These websites use points, badges, and leaderboards, which motivate students to complete homework and learn challenging concepts of physics. It focused on certain examples, i.e.,: Khan Academy because it is well known for its video learning, Khan Academy also employs interactive practice exercises and quizzes where the students can acquire points and see their progress. Physics content on the website comes in bite-sized lessons so students are able to learn and accomplish one idea at a time (Richter & Kickmeier-Rust, 2025).

Journal of Information Systems Engineering and Management
2025, 10(4)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

The current study found that balancing enjoyment with learning, as one of the common concerns regarding gamified learning is that entertainment might take precedence over learning. If the game elements are too complicated or the rewards too enticing, students may be more focused on winning or competing than actually learning the physics concepts being taught. This is at risk of surface learning or lack of conceptual knowledge. Teachers need to balance enjoyment and value of learning if they are to succeed so that gamified content is aligned with course learning outcomes in a proper manner (Zakaria & Mahat, 2024). Physics activity and games ought to be meaningful leading learners to struggle through theoretical ideas meaningfully as opposed to superficially e.g., merely in answers or marks. Carefully planned game activities based on critical thinking, problem-solving, and applying concepts of physics can be spared this difficulty. Puzzles or games requiring manipulation of physical variables to achieve wanted outcomes (e.g., choosing the correct path of a projectile to hit a target) exercises the students' capacity to apply key concepts like motion, force, and energy. Also, the game's feedback mechanisms should provide positive feedback as well as constructive criticism to direct students towards improving their understanding of the subject matter (Beltozar-Clemente & Díaz-Vega, 2024). This will make students focus on the learning process, as opposed to points they receive.

This study viewed that assessment and evaluation problems, as in traditional physics courses, tend to be exams, quizzes, and written homework, which easily assess students' theoretical understanding and problem-solving skills. But making gamification a part of the assessment raises the problem of how to measure the learning progress and performance of the students accurately (Atsuwe & Vaava, 2022). The gamification process would lean more towards encouraging participation and work completion as opposed to determining the actual understanding of the material for a student. In order to strike the balance required of the assessment, instructors can mix traditional methods of testing with gamification. For instance, conventional tests or quizzes can still be used to assess the students' grasp of theoretical concepts, while gamified exercises can be used to assess their capacity to use what they have learned in practical situations. A possibility is to create "milestones" or "boss battles" in the gamified environment that test the students' competence in fundamental concepts. These challenges can require the students to respond to long questions or to compute complex problems and thus demonstrate understanding of the concept. The teacher can also provide continuous formative feedback throughout the game to ensure that students receive guidance and feedback along the way (Al-Mutawah et al., 2018). By including a combination of performance-based assessments (e.g., finishing levels, challenges, or simulations) and traditional measures (e.g., written exams and projects), one can better understand the student's learning and progress (Mahmoud, 2009).

This study proved that breaking through the "one-size-fits-all" approach, since gamification is often premised on formulaic models that will not accommodate all learners' needs or learning style. A "one-size-fits-all" approach disenfranchises students who need more individuation or learning from other sources. Physics as a subject that is very mathematical and analytical may benefit from other types of gamified exercises based on levels of students' understanding (Zourmpakis et al., 2024). Apart from this, to solve this issue, educators can create a range of gamified experiences that can accommodate different learning styles and levels of competence. Some learners, for example, may require a lot of problem-based games, while others may excel with story-based challenges with physics concepts incorporated in a story or real-world situation. Tailored gamification, where students are able to choose their own "quests" or challenges from among a series of possibilities depending on what they are interested in and need to learn, can also provide more customized learning experiences. Adaptive learning technologies can also be used to adjust the level of gamified challenge based on a student's performance, so that each student is appropriately challenged but assisted (Mahmoud, 2014).

The current study explored some of the new methods of applying gamification in college physics. In applying gamification in college physics, instructors are meant to align game mechanics with learning objectives in order to have optimum impact. Gamification may be achieved through some of its powerful methods such as: level progression, Competitions and leaderboards, achievement badges and rewards, Collaborative teamwork and challenges, and storytelling and scenario-based learning (Alonso-Sánchez et al., 2025). Level advancement can be done by dividing the course into small chunks, and each chunk is one level in the game. One can unlock the subsequent level after they have mastered certain challenges, quizzes, or assignments. It will motivate the students by giving them a sense of achievement and encourage them to know more (Naldoza & Bilar, 2024). Competition and ranking may be added by a leaderboard mechanism that may be included to bring in competition among the students in a positive manner. This, by tracking their performance and ranking the performance, prompts the students to deliver better performance and engage with

Research Article

the content more actively. Competitions can be provided in the form of physics challenges where students use concepts to solve real-life problems or conduct experiments (Theodoropoulou et al., 2024).

Achievement badges and rewards can be done by students who can earn badges or points for completion of assignments, achieving some milestones, or mastery of some physics concepts. The rewards reinforce good behaviour and provide a visual explanation of the progress achieved by a student. Providing the badges with a topical relevance to portray particular subject matter, i.e., "Master of Energy" or "Force Expert," can add meaning to the rewards(Mahmoud, 2023). Collaborative teamwork and challenges can be made possible by gamification which may or may not be competitive in nature; it can also encourage collaboration. By using team-based physics problems, students can work together in solving difficult problems, share ideas, and learn from each other. Teamwork offers a sense of community while allowing students to learn difficult topics in a team (Al-Mutawah et al., 2019).Storytelling and scenario learning can also be achieved through the creation of stories or scenarios that involve problem solving with their physics. For example, students can be asked to travel a spaceship through space by problem solving with physics, applying principles of motion, and experimenting with variables to reach their destination with their spaceship. The story line makes the learning more interactive by placing the concepts of physics within a real-world scenario (Hung et al., 2015). The use of gamification in learning physics can be facilitated by several digital tools and applications. Digital tools help in restructuring traditional teaching methods and enable teachers to create interactive, interesting learning experiences(CHAIPIDECH et al., 2024). Current study found some noteworthy benefits, applications and strategies that are being currently employed in gamified physics learning.

Conclusion

Some suggestions and proposals were made for the future development of gamification in college physics courses. These proposals are addressed to both the design and implementation of gamified learning environments so that their potential to contribute to the promotion of student engagement, learning outcomes, and classroom dynamics is optimized. Clever gamification design to support individual learning requirements of the course in physics is one such suggestion. Points, leaderboards, and badges are some video game mechanics to be explicitly linked with learning goals. Learning huge concepts in physics or solving challenging problems for points, for instance, encourages students to spend time on mundane learning tasks. Such integration causes the game elements to enhance, rather than take away from, the underlying academic subject matter. The study suggests the use of various gamified features to cater to different student interests and learning styles. Quizzes, interactive simulations, virtual labs, and peer challenges are some of the features that can attract students with varying interests and physics proficiency. Providing a mix of group and individual activities (e.g., competitions or group challenges) can also promote independent learning and collaboration, making the learning environment more dynamic and inclusive. The study concerns the worth of including digital technologies and platforms with immediate feedback, adaptive learning sequences, and gentle monitoring of improvement. Computer programs can offer immediate correct feedback, a critical avenue to monitor correct understanding and correction of gaps in misconceptions. Teachers are required to utilize such tools in monitoring students' progress and tailoring follow-up lessons or activities based on performance, creating an adaptive and customized learning process. Because most of the concepts in physics are intangible, the research recommends incorporating virtual labs and simulations in gamified learning. Simulations enable students to see and engage with intricate physical systems, thus making it easier to understand theories and principles. Gamifying the simulations (i.e., through levels or challenges) can make learning more enjoyable and allow students to learn various consequences depending on their choice. Most basic of all may be the suggestion that game systems be designed so that mastery and improvement are rewarded rather than competition. In place of focus on winning or rankings, the research suggests that the addition of "levels" or "milestones" to offer some signal of progress as one has proceeded thus far might trigger a growth mindset in the sense that students will be incentivized to acquire knowledge by first trying and doing better at it and not getting deterred from the success of others.

The studies indicate providing the students with some control over the process of their learning. Gamified settings with chances for the students to make choices regarding how they progress (e.g., selection from multiple challenges or themes) can enhance motivation and participation. Furthermore, adding time for self-directed learning allows for returning to difficult spots or advancing after the students are confident of having learned, which is appropriate for a wide range of ability and rates of learning. Among the recommendations in the research is that thoughtfully construct gamification items that are adequately balanced and fair. This includes not giving unduly complex and unrealistic

Research Article

assignments that will demotivate students, and giving each student a level playing ground upon which they, regardless of the entry skill set, can thrive. For example, making an award or an achievement attainable by students of varying levels of understanding will help eliminate frustration and disengagement. The study emphasizes cooperation through gamification. For example, students may be requested to critique and offer constructive criticism of each other's work through peer-to-peer review. Team learning, augmented with competitive or cooperative game design, can engage student interaction, foster collective problem-solving, and foster communication skills. This method also encourages building a community in class, which leads to increased participation. Successful gamification in school requires teachers to be trained in the use of technology and how to carry out gamified learning processes. Teachers require training from the research by taking professional courses through which they learn how to design, deploy, and track gamified content. Besides, periodic support for the teachers during the deployment phase will most likely prepare them to address any arising challenges. Ongoing observation and gamification strategy adjustment based on students' feedback and outcomes is the inference of the research. Teachers should observe how the gamified aspects are performing and be ready to change in order to optimize them. Questionnaires, interviews, or focus groups would help in understanding students' opinion on whether the gamified learning environment is well and how happy it makes them, and thereby gaining crucial ideas on what needs to be improved in it. Finally, the research suggests keeping technical limitations in mind and offering accessibility to gamification tools to all learners. The institutions should take care not to have impediments in the way of technology unavailability, digital literacy variation, or special needs consideration for disabled students. Developing easy-to-use gamification platforms and equipping students with sufficient resources to participate in gamified learning is essential so that it can have its maximum impact.

University physics games are an excellent means of enhancing the fun of learning and engaging students actively in interactive, experiential, and challenging learning. Educators can, with the use of electronic media and game design, develop more improved physics learning, improve student engagement, and maximize active learning. With the rising developments in technology, the gamified physics education of the future holds the promise of even more immersive and innovative methods of teaching students that will shape their learning experience for decades to come. Overall, the research provides a comprehensive set of recommendations that can help make the incorporation of gamification in college-level physics education possible. These standards are meant to enhance student engagement, learning outcomes, and overall classroom experience through strategic use of an equal balance of game mechanics, digital tools, and adaptive learning principles. Through judicious use of these practices, educators can make learning environments more interactive, motivating, and effective for their students.

References

[1] AKSAY, B., ORAN, S., AKTAŞ, M., YILDIRIM, E., & KILIÇ, F. Gamification as a social phenomenon and gamification heuristics criteria from social sciences perspective.

[2] Al-Mutawah, M. A., Alghazo, Y. M., Mahmoud, E. Y., Preji, N., & Thomas, R. (2021). Designing a Need-Based Integrated" STEAM" Framework for Primary Schools in Bahrain. *International Journal of Education and Practice*, *9*(3), 602-612. https://doi.org/https://doi.org/10.18488/journal.61.2021.93.602.612

[3] Al-Mutawah, M. A., Eid, A., Thomas, R., Mahmoud, E. Y., & Fateel, M. J. (2018). Analysing Mathematical Abilities of High School Graduates. *KnE Social Sciences*, 26–41-26–41.

[4] Al-Mutawah, M. A., Thomas, R., Eid, A., Mahmoud, E. Y., & Fateel, M. J. (2019). Conceptual understanding, procedural knowledge and problem-solving skills in mathematics: High school graduates work analysis and standpoints. *International Journal of Education and Practice*, *7*(3), 258-273. https://doi.org/https://doi.org/10.18488/journal.61.2019.73.258.273

[5] Al-Mutawah, M. A., Thomas, R., Preji, N., Alghazo, Y. M., & Mahmoud, E. Y. (2022). Theoretical and conceptual framework for a STEAM-based integrated curriculum. *Journal of Positive School Psychology*, 5045–5067-5045–5067. https://doi.org/https://journalppw.com/index.php/jpsp/article/view/7468

[6] Alonso-Sánchez, J. A., Alonso, J. L. N., & Santana-Monagas, E. (2025). Gamification in Higher Education: A Case Study in Educational Sciences. *TechTrends*, 1-12. https://doi.org/https://doi.org/10.1007/s11528-025-01056-2

[7] Alqarni, A., & Alabdan, M. (2022). Exploring teachers' perspectives on using gamification in teaching science in Saudi Arabia. *International Journal of Advanced and Applied Sciences*, *9*(9), 41-52.

[8] Atsuwe, B., & Vaava, A. T. (2022). Effectiveness of the use of gamification by teachers of physics in secondary schools in Buruku local government area of Benue State. *International Journal of Academic Multidisciplinary Research*, *6*(8), 6-11.

[9] Beltozar-Clemente, S., & Díaz-Vega, E. (2024). Physics XP: Integration of ChatGPT and Gamification to Improve Academic Performance and Motivation in Physics 1 Course. *International Journal of Engineering Pedagogy*, *14*(6). https://doi.org/https://doi.org/10.3991/ijep.v14i6.47127

[10] CHAIPIDECH, P., PREMTHAISONG, S., PONDEE, P., & SRISAWASDI, N. (2024). Exploring the Effect of Marker-Based AR Gamification on Primary Students' Science Concepts and Motivation. International Conference on Computers in Education,

[11] Davis, J. P., & Bellocchi, A. (2020). Gamification of SSI's as a science pedagogy: Toward a critical rationality in teaching science. *Science Teacher Education for Responsible Citizenship: Towards a Pedagogy for Relevance through Socioscientific Issues*, 101-116. https://doi.org/https://doi.org/10.1007/978-3-030-40229-7_7

[12] Diaz, A. F., & Estoque-Loñez, H. (2024). A Meta-Analysis on the Effectiveness of Gamification on Student Learning Achievement. *International Journal of Education in Mathematics, Science and Technology*, *12*(5), 1236-1253. https://doi.org/https://doi.org/10.46328/ijemst.4185

[13] Gaurina, M., Alajbeg, A., & Weber, I. (2025). The Power of Play: Investigating the Effects of Gamification on Motivation and Engagement in Physics Classroom. *Education sciences*, *15*(1), 104. https://doi.org/https://doi.org/10.3390/educsci15010104

[14] Hung, W., Flom, E., Manu, J., & Mahmoud, E. (2015). A review of the instructional practices for promoting online learning communities. *Journal of Interactive Learning Research*, *26*(3), 229-252.

[15] Jiménez-Valverde, G., Heras-Paniagua, C., Fabre-Mitjans, N., & Calafell-Subirà, G. (2024). Gamifying Teacher Education with FantasyClass: Effects on Attitudes towards Physics and Chemistry among Preservice Primary Teachers. *Education Sciences*, *14*(8), 822.

[16] KOMOLAFE, O. G. (2022). *i IMPACTS OF MODES OF GAMIFICATION ON SENIOR SECONDARY SCHOOL STUDENTS'LEARNING OUTCOMES IN PHYSICS IN ONDO CITY, NIGERIA*

[17] Mahmoud, E. (2014). *Book review: Technology-enhanced teaching and learning: Leading and supporting the transformation on your campus by Barone and Hagner*. Paper presented at the University of North Dakota Scholarly Forum, Grand Forks, ND, USA. http://und.edu/news/2015/02/2014-scholarly-forum.cfm

[18] Mahmoud, E. (2023). Practical technology integration into mathematics teaching in elementary education: Instructional design model, teaching strategies, and assessment techniques. *Remittances Review*, *8*(4), 2912-2932. https://doi.org/https://doi.org/10.33182/rr.v8i4.202

[19] Mahmoud, E. H., Narjes. (2009). The Effect of Using Instructional Multimedia on Improving Second Basic Grade Students' Communication Skills in Arabic Language in Jordan.

[20] Mahmoud, E. Y. R. (2015). *Use of C-map as a cognitive tool in collaborative and individual concept mapping for enhancing ELL students' reading comprehension*. The University of North Dakota.

[21] Naldoza, L. A., & Bilar, B. (2024). Effectiveness of Gamification Strategy in Teaching Science. *International Journal of Research and Innovation in Social Science*, *8*(5), 76-85. https://doi.org/https://doi.org/10.47772/ijriss.2024.805007

[22] Pereira, G., Berti, I. C. L. W., Andrade, M., Barros, V., Caetano, A. M. P., Silva, R., Valente, V., & Paletta, F. C. (2024). Teaching to Research: The Use of Gamification in Pedagogical Experiences. In *Smart Learning Solutions for Sustainable Societies* (pp. 179-191). Springer. https://doi.org/https://doi.org/10.1007/978-981-97-0661-7_13

[23] Richter, K., & Kickmeier-Rust, M. (2025). Gamification in Physics Education: Play Your Way to Better Learning. *International Journal of Serious Games*, *12*(1), 59-81.

[24] Roleda, L. S. (2018). Gamification: Enhancing students' motivation and performance in grade 10 physics. *Advanced Science Letters*, *24*(11), 8094-8097. https://doi.org/https://doi.org/10.1166/asl.2018.12499

[25] Singh, B., Deepak, D., Sharma, D., Agrawal, M., & Mishra, A. (2025). Investigating educational platforms employ gamification to improve learning and student engagement – An empirical study. *Journal of Informatics Education and Research*. https://doi.org/https://doi.org/10.52783/jier.v5i1.2130

[26] Theodoropoulou, K., Xenakis, A., Antonis, K., Avramopoulos, A., & Vavougios, D. (2024). A Survey on Quantum Literacy within Gamification in Science Education. *Authorea Preprints*.

Research Article

[27] Welborn, J. E. (2023). School Leaders' Use and Value of Culturally Proficient Educational Practice in Rural, K-12 Public Schools Across the United States. *Education Leadership Review*, *24*(1).
[28] Zakaria, N. Z. S., & Mahat, H. (2024). Comprehensive Needs Analysis for Development Teaching Model Based on Gamification in Environmental Education. *International Journal of Research and Innovation in Social Science*, *8*(12), 3399-3405.
[29] Zourmpakis, A.-I., Kalogiannakis, M., & Papadakis, S. (2024). The Effects of Adaptive Gamification in Science Learning: A Comparison Between Traditional Inquiry-Based Learning and Gender Differences. *Computers*, *13*(12), 324. https://doi.org/https://doi.org/10.3390/computers13120324