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A systematic literature review of the impact of gamification instruction on students' problem-solving skills

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ABSTRACT

Gamification is a popular approach to teaching and learning in education in recent years, it provides the flexible integration of various game elements into educational activities to achieve instructional objectives. This approach has the potential to enhance student skills through interactive communication and motivation and has, sparked interest and discussion in many fields, including education. This review assesses the impact of gamification on student skills in terms of teaching methods, learning outcomes, and challenges faced. The study analyzed 21 research articles from three databases, Web of Science (WoS), Scopus, and ERIC, up to November 2023. The findings were grouped into three main themes: teaching implementation and methods (8 articles), learning outcomes and skill development (8 articles), and challenges and improvement strategies (5 articles). The findings suggest that although gamification has gained more results in the field of education, especially in terms of improving students' skills and teaching effectiveness, there are shortcomings in integrating it with professional education. This review mainly highlights the impact of gamification in the development of students' skills while considering gamification in conjunction with other aspects of education to illustrate the need for ongoing research and further exploration in the field of education.

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1. INTRODUCTION

Modern technology has been integrated into all aspects of people's learning and life and has become more and more closely integrated with education, making it difficult for a single traditional teaching method to achieve the desired teaching goals and effects, which is especially obvious for digital natives [1]. Traditional teaching methods are not sufficiently engaging and effective, and education is encountering unprecedented challenges. Therefore, the use of artificial intelligence, virtual reality, and other technologies allows for the integration of modern technology into modern education in order to provide a more personalized service and a more relevant and interactive learning experience [2].

From the perspective of learning theories, teaching methods primarily include behaviorism, cognitivism, and constructivism. Behaviorism, represented by Watson and Skinner focuses on the influence of the environment on subjective psychological factors, believing that all learning behaviors are carried out through conditioned reflexes, emphasizing the influence of external factors on internal psychological states. This theory suggests that human behavior is closely related to external stimuli; learning behavior can be regulated through reinforcement and punishment [3]. With Piaget and Bruner as key figures, cognitivism views learning as a process in which the learner comprehends, processes, or stores and organizes the various

resources received, and through this process, a knowledge structure is formed [4]. Constructivism, represented by Vygotsky, emphasized that each person will actively construct a knowledge system based on their own experience, background, and cognitive structure rather than passively receiving it from the outside world, highlighting the active participation of the learner and the social construction of knowledge [5].

Regarding practical implementation, teaching methods include lecturing, discussion, demonstration, and practice, widely used to achieve desired educational outcomes. These traditional methods still hold value in modern educational contexts. Behaviorism applies to classroom management and teaching strategies [6]. Cognitivism provides strategies for processing and organizing information, enhancing students' understanding and memory [7]. Constructivism is central in project-based, cooperative learning and situational teaching, helping students construct knowledge in real-world settings [8]. Regardless of the teaching method, it exists to achieve the goals of teaching and learning, and the study was designed to summarize and review one of the teaching methods in modern education - gamified teaching.

Gamification in teaching, emerging with the development of educational technology in the early 21st century, has expanded from primary education to higher education and professional training [9]. With its unique interactivity and engagement, this method transcends borders and cultures and is adopted globally [10]. Gamification in teaching is not merely introducing games into the educational environment but using game design elements and thinking to stimulate student interest, increase participation, and enhance learning outcomes. Gamification has received much attention because it successfully combines game incentives with educational goals, engages students, and promotes deep learning [11]. Unlike traditional methods, gamification emphasizes practice, exploration, and collaboration, not just knowledge transfer and recall [12]. Its appeal stems from the immediate feedback, reward mechanisms, and challenges games provide, often lacking in traditional methods. In the current educational field, gamification is a promising, innovative approach many schools and institutions use to increase student engagement and learning outcomes [13]. This approach is advantageous in boosting students' critical and creative thinking abilities but also can ignite students' passion for learning [14]. Using gamification in the classroom, students can enhance their level of engagement and attention while developing their problem-solving skills [15], [16].

Although gamification teaching methods have been widely explored, no systematic and comprehensive review of their impact on enhancing students' problem-solving skills has been done. Therefore, this paper aims to provide educators, researchers and policymakers with a clear and comprehensive perspective to understand better gamification's potential value and limitations in teaching and learning. Through a systematic review of the relevant literature, this study provides an overview of the current status of gamification in promoting students' skill development, implementation of teaching methods, challenges faced, and possible strategies for improvement to provide solid support and clear guidance for research in this field.

2. RESEARCH METHOD

2.1. Method

Many researchers have applied this approach to gamification elements across different fields and educational stages. However, only a few studies analyze gamification's impact on students' relevant skills. This section will systematically analyze the impact of gamification on students' problem-solving skills. The following part introduces the research methodology established in the current study. This research will be divided into three parts: i) teaching implementation and methods; ii) learning outcomes and skill development; and iii) challenges and improvement strategies. This section then systematically reviews and synthesizes scientific literature to distinguish, filter, and analyze significant gamification research. Finally, the results are summarized and categorized, identifying future paths for gamification development.

This analysis utilizes the preferred reporting items for systematic reviews and meta-analyses (PRISMA) method, a standard for documenting systematic literature reviews. Generally, publishing rules help authors assess and review the quality and rigor of comments, providing relevant and necessary details. PRISMA also emphasizes the assessment of randomized study surveys, an important feature in systematic analysis reports of various types of studies as shown in Figure 1 [17].

This study will use Scopus, Web of Science (WoS), and ERIC as electronic databases to evaluate this research method. The database search for this review includes databases related to education, information technology, and social sciences, as there is no perfect and detailed database. The systematic review process can be divided into three stages, each responsible for selecting the most pertinent papers for the study.

2.2. Identification

The systematic review process is divided into three stages, each responsible for selecting the most pertinent papers for this study. The first step that needs to be completed is identification, where relevant literature is sought in a wide range of databases and resources. This usually includes defining keywords, search terms, and the databases included. Researchers must ensure that the search strategy is comprehensive and specific to capture all relevant studies. Therefore, after identifying all relevant keywords, search strings for the Scopus, WoS, and ERIC databases have been formulated. The specifics in Table 1 are the strings that are used when performing searches in each database. The current research successfully retrieved 316 journal papers from the three databases in the systematic review's first step.

Table 1. The search strings

Databases	Search strings
Scopus	TITLE-ABS-KEY (problem-solving AND skill AND gamification) AND (LIMIT-TO (PUBYEAR, 2014) OR LIMIT-TO (PUBYEAR, 2015) OR LIMIT-TO (PUBYEAR, 2016) OR LIMIT-TO (PUBYEAR, 2017) OR LIMIT-TO (PUBYEAR, 2018) OR LIMIT-TO (PUBYEAR, 2019) OR LIMIT-TO (PUBYEAR, 2020) OR LIMIT-TO (PUBYEAR, 2021) OR LIMIT-TO (PUBYEAR, 2022) OR LIMIT-TO (PUBYEAR, 2023)) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English"))
WoS	(ALL= (problem-solving AND skill AND gamification)) AND (PY== ("2023" OR "2022" OR "2021" OR "2020" OR "2019" OR "2018" OR "2017" OR "2016" OR "2015" OR "2014") AND DT==("ARTICLE") AND LA==("ENGLISH"))
ERIC	(ALL= (problem-solving AND skill AND gamification)) AND (PY== ("2023" OR "2022" OR "2021" OR "2020" OR "2019" OR "2018" OR "2017" OR "2016" OR "2015" OR "2014") AND DT== ("PUB JOURNAL ARTICLE"))

2.3. Screening

In this stage, this research initially focused on research articles, as they are the primary and most reliable source of information on the impact of gamification in teaching student skills. To ensure the focus and depth of the research, this research excluded other forms of publications such as systematic reviews, commentaries, meta-analyses, meta-syntheses, series, book chapters, and conference proceedings. Moreover, this research only considered papers written in English to ensure the universality and comprehensibility of the research. Importantly, this research set a 10-year time frame, from 2014 to 2023, to ensure the timeliness of the research. Simultaneously, this research screened for duplicate articles, eliminating repeated papers. Based on these strict screening criteria, this research excluded 222 papers that did not meet the requirements, thereby conducting a more in-depth eligibility review of the remaining literature. With this, the most relevant and up-to-date research on the topic can be filtered.

2.4. Eligibility

In the eligibility stage, the objective is to further review the articles that have passed the previous stage of screening to ensure that these papers meet the specific requirements and criteria of the study. This stage is crucial in the literature review process as it is the final hurdle in determining the quality and relevance of the literature included in the review. The research will assess the applicability of each paper by conducting an in-depth review of the research methodology, study population, and results, focusing on the presence of a clear research question, sound research design, appropriate analytical methods, and reliable conclusions. In addition, replicability and transparency of the study are also important assessment criteria at this stage. In this stage, the eligibility review, 41 articles were prepared. At this stage, this research conducted a comprehensive review of the titles and main contents of all articles to ensure compliance with the inclusion requirements and alignment with the current research purpose of this study. As a result, 20 reports were excluded due to a lack of clear relevance to the research objectives. Finally, 21 articles were available for review. Table 2 shows the criteria used in conducting the screening to ensure that the included articles met the requirements.

Table 2. The selection criterion

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeline	2014-2023	<2014
Literature type	Journal (only research articles)	Journal (book chapter, conference proceeding)

2.5. Date abstraction and analysis

In this phase, this research will extract key data from the 21 articles that have passed the previous screening and review and conduct an in-depth analysis. The data extraction process will focus on each article's main research purpose, methods, results, and specific discussions on the impact of gamified teaching. This research will analyze these studies to investigate the link between gamification and students' talents. In addition, this study will analyze multiple studies that have been conducted, as well as new methods and techniques used in research design, data collection, and data analysis. The research will synthesize this data to determine the impact of gamified instruction on students' skill development. In order to provide an exhaustive assessment of the effectiveness of gamified training, this research will consider both quantitative and qualitative methods of data collection and analysis. The research will also identify and discuss any significant trends, challenges, and future research gaps found in the investigations that have been conducted. These findings are based on existing research. This in-depth study will provide valuable insights for researchers and educators to help them grasp and apply the most successful gamified educational technologies. In addition, the results of the analysis will determine future research directions. Ultimately, the objective of this painstakingly analytical process is to make a substantial contribution to the development of theory and practice in gamified education. This is the ultimate goal of this approach.

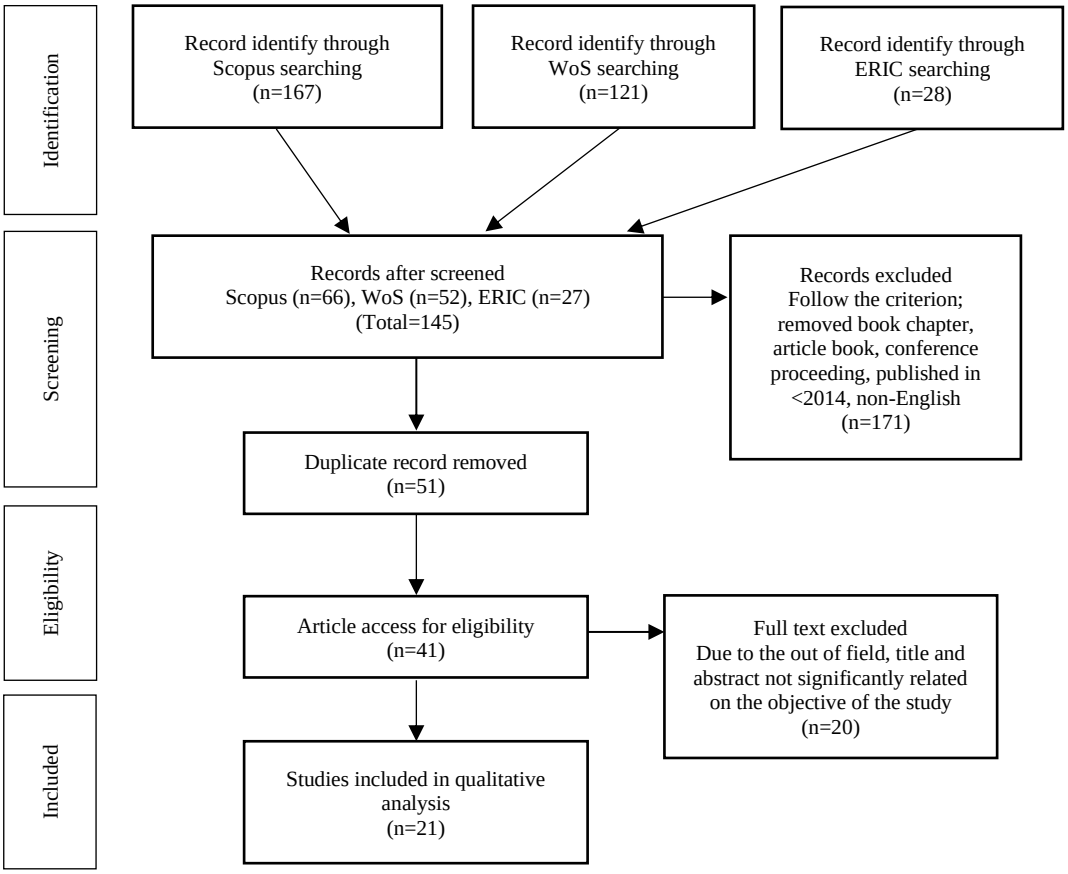

Figure 1. Flow diagram of the proposed searching study [18]

3. RESULTS AND DISCUSSION

Since its inception, gamified teaching has evolved from a concept considered to be on the fringe to an approach currently being accepted by most schools and is now an integral component of the modern educational system [18]. Its core significance lies in stimulating learners' enthusiasm and participation through the elements and mechanisms of games, thereby transforming traditional teaching models [13]. The introduction of gamified teaching has brought innovative teaching methods and more efficient learning processes to education, and it indicates potential revolutionary changes in the future of education, opening new pathways for motivating students to actively learn and develop key skills [19]. This study employed retrieval techniques to extract and analyze 21 articles. All articles were categorized into three main themes:

teaching implementation and methods (8 articles), learning outcomes and skill development (8 articles), and challenges and improvement strategies (5 articles). Table 3 shows the 21 articles found based on the proposed search criteria, containing basic information such as the author of the article, and the article's title.

Table 3. The research article's finding based on the proposed search criterion

No	Author	Title	Scopus	WoS	ERIC	Remarks
1	Lorenzo-Lledó *et al.*	Application of gamification in early childhood education and primary education: thematic analysis	✓	✓		Teaching implementation and methods
2	Lee *et al.*	Collaborative creativity among undergraduate students as game creators during gamification in a university-wide elective course	✓	✓	✓	Teaching implementation and methods
3	Cheng *et al.*	Enhancing student's computational thinking skills with student-generated questions strategy in a game-based learning platform	✓	✓		Learning outcomes and skills development
4	Schöbel *et al.*	Gamifying online training in management education to support emotional engagement and problem-solving skills	✓	✓	✓	Challenges and strategies for improvement
5	Çetin *et al.*	The effect of gamified adaptive intelligent tutoring system ArtiBos on problem-solving skills	✓		✓	Learning outcomes and skills development
6	Dangprasert	The impact of gamification on creative and innovative skills of graduate students	✓			Learning outcomes and skills development
7	Zabala-Vargas *et al.*	Didactic strategy mediated by games in the teaching of mathematics in first-year engineering students	✓		✓	Teaching implementation and methods
8	Sannathimmappa *et al.*	Learning out of the box: Fostering intellectual curiosity and learning skills among the medical students through gamification	✓	✓		Teaching implementation and methods
9	Poonsawad *et al.*	Synthesis of problem-based interactive digital storytelling learning model under gamification environment promotes students' problem-solving skills	✓	✓		Teaching implementation and methods
10	Soboleva *et al.*	Formation of computational thinking skills using computer games in teaching mathematics	✓		✓	Teaching implementation and methods
11	Park *et al.*	Leaderboard design principles to enhance learning and motivation in a gamified educational environment: development study	✓	✓		Challenges and strategies for improvement
12	Bistulfi	Pushing active learning into assessment with a genetics escape-room final: Gamification to develop team skills in STEM, on ground and online	✓			Learning outcomes and skills development
13	Yu *et al.*	The effect of educational games on learning outcomes, student motivation, engagement and satisfaction	✓	✓	✓	Teaching implementation and methods
14	Asigigan *et al.*	The effect of gamified STEM practices on students' intrinsic motivation, critical thinking disposition levels, and perception of problem-solving skills	✓	✓	✓	Learning outcomes and skills development
15	Kladchuen *et al.*	The synthesis of a model of problem-based learning with the gamification concept to enhance the problem-solving skills for high vocational certificate	✓	✓		Learning outcomes and skills development
16	Mee *et al.*	Role of gamification in classroom teaching: pre-service teachers' view	✓		✓	Challenges and strategies for improvement
17	Supeno *et al.*	Game development to train critical thinking in science subjects using model of digital game based learning-instructional design	✓			Learning outcomes and skills development
18	Thongmak	The student experience of student-centered learning methods: comparing gamification and flipped classroom	✓	✓	✓	Challenges and strategies for improvement
19	O'Brien *et al.*	Gamifying instruction and engaging students with Breakout EDU			✓	Challenges and strategies for improvement
20	Sulphey *et al.*	Game based learning as an aid for extenuating higher education sector issues-the case of Saudi Arabia	✓			Learning outcomes and skills development
21	Machajewski	Gamification strategies in a hybrid exemplary college course			✓	Teaching implementation and methods

3.1. Teaching implementation and methods

3.1.1. Gamification teaching strategies

In the current field of education, gamification teaching strategies are increasingly becoming an important instructional method. Their core lies in enhancing the learning experience by utilizing elements of games. The use of gamified group projects and game creation in higher education has found that gamification methods enhance undergraduate students' collaborative creativity and have significant implications for developing learning and innovation skills [20]. Integration of digital gamification materials into the mathematics teaching and learning process. Through gamification, with the main focus on developing students' computational thinking skills as the core objective, the results shed light on the great contribution of gamification principles to improving the quality of students' mathematics teaching and learning [21].

The digital storytelling learning model is interactive and focuses on problems in a gamified environment. Implementing this approach not only helps students improve their problem-solving skills, but also instils a sense of achievement and demonstrates their various abilities [22]. The effectiveness of educational games is worth exploring. A comprehensive investigation of the impact of gamified learning on students' academic performance, problem-solving skills, knowledge acquisition, skill development and attitudes found that both the beneficial impact of gamification in promoting motivation to learn and the role of gamification in increasing student satisfaction were very important. At the same time, this study demonstrates the wide application and far-reaching impact of gamified teaching strategies in education, which is of great practical importance [23]. In addition, the study deals with the difficulties that must be overcome to successfully deploy gamified teaching and the preliminary arrangements that need to be made if teaching and learning are to be made more effective.

3.1.2. Educational stages and subject applications

When using gamified teaching strategies, it is important to understand the level of education and the subject matter to ensure that gamified teaching is effective and appropriate at that educational level. This understanding is essential because it affects the effectiveness of the strategies. Research on the use of gamification in early childhood and primary education has found that gamification greatly improves the learning and collaborative skills of 10 to 12-year-olds, and this is particularly evident for children enrolled in science programs. The objective of gamification is to include students in problem-solving by providing them with opportunities to increase their level of thinking through game principles [24]. Scholars have also investigated the use of gamified instruction in higher education during the past few years.

A study of the impact of gamification on first-year engineering mathematics students showed that students' ability to collaborate and their enthusiasm for learning improved significantly using gamification teaching strategies [25]. Another study, quite similar to this one, explored the impact of gamification on the cognitive abilities of medical students, focusing on the potential of gamification to improve students' understanding and communication of what they have learned [26]. With the development of technological applications, it is also important to focus on the use of digital gamification in curriculum design, especially its impact on the quality of teaching and learning, with research pointing to the fact that curricula designed through gamification can be effective in shaping the learning experience of the students, especially in modern educational environments where it is shown to be important [27].

At various educational levels and fields, including early childhood education, higher education, fundamental sciences, and professional courses, gamification teaching strategies have been demonstrated to be of significant assistance. This includes a wide range of settings and fields. Because of this, they are adaptable to a broad variety of educational environments. The many applications of these strategies not only assist students in improving their academic and collaborative skills but also stimulate student engagement and professional competencies provided they are implemented properly. This is because these techniques may be utilized in a broad variety of contexts.

3.2. Learning outcomes and skills development

Previous studies have been conducted to study the use of a wide range of gamification strategies across several educational levels. The implementation of modern teaching strategies can significantly increase the level of student engagement and interest in the subject and enhance the effectiveness of teaching and learning by utilizing student initiative in the learning process. Research has shown that gamified teaching strategies have a positive impact on subject matter talent and motivation to learn, increase student participation in teaching and learning, and effectively motivate students to develop competencies in all areas of their lives.

3.2.1. Skill cultivation and subject competence

Gamified learning promotes effectiveness in computational thinking skills when students are confronted with problems and problem-solving, and research into the formation of problem-solving strategies has found that gamified approaches can significantly enhance students' computational thinking skills and

motivation to learn, stimulate interest and understanding of complex technical concepts, and inspire students to learn [28]. The gamified teaching method is an effective teaching method that can help students better understand the difficulties of what they are learning. Building a gamified teaching environment, enriching a variety of learning styles, and fostering students' creativity and problem-solving skills are all areas of research in gamified teaching and learning [29]. Gamified science, technology, engineering, and mathematics (STEM) activities are an important approach to developing children's critical thinking skills, problem-solving skills, intrinsic motivation drives, and other competencies. Therefore, gamified learning is an important approach in the development of comprehensive academic skills [30]. When it comes to developing students' creative and imaginative thinking, it has been established that the introduction of gamification aspects, such as rewards, practice, and a range of perspectives, significantly contributes to improving students' creative and inventive thinking [31]. Gamification teaching strategies significantly impact students' development of key skills in various subject areas, from computational thinking to creativity to critical and innovative thinking. That being said, it is conceivable to conclude that gamified teaching approaches have a major influence on the development of students' fundamental abilities across a wide range of subject areas.

3.2.2. Educational outcomes and student feedback

A study of higher vocational college students found that an integrated approach to learning that combines confronting basic problems and gamified concepts strengthens students' problem-solving skills and confirms the effectiveness of gamified instruction in motivating students [32]. Intelligent systems generated along with technological developments are also beginning to be applied, and the application of the gamified adaptive intelligent tutoring system ArtiBos, on the other hand, has been evaluated through a qualitative approach to assess the system's design features and functionality. The results showed that the gamified ArtiBos system positively enhanced students' problem-solving skills [33]. The role of gamification in stimulating emotions of excitement and thrill in the learning process is also evident in the fact that digital game-based learning methods effectively enhance students' problem-solving and thinking skills and provide innovative solutions for the educational environment [34]. Gamification can even be used to transform the subject comprehensive final exam, which not only significantly improves students' team skills and problem-solving abilities but also effectively reduces exam stress and proves its value as an assessment tool [35]. Students' ability to collaborate effectively and find solutions to issues, as well as their ability to successfully reduce their anxiety over exams, is significantly improved by the use of gamification. Not only can the implementation of gamification in educational settings make the process of skill acquisition simpler, but it also positively influences the learning experiences and feedback that students are provided with. It is proof of the importance it possesses in the field of education that it has the potential to assist in increasing problem-solving abilities, teamwork skills, exam experiences, and the desire to study.

3.3. Challenges and strategies for improvement

3.3.1. Motivation stimulation and participation enhancement

Students have the potential to experience an overall development in their skill set when they participate in gamified training, which may be done in a wide range of educational settings. However, it will probably face several challenges. When it is put into operation, it will be essential to take measures to overcome these challenges after they have been encountered. Incorporating gamification elements such as points and badges can encourage learners' affective engagement, significantly improve their problem-solving skills, and demonstrate the potential of gamification in generating learner enthusiasm and engagement, all potential outcomes of incorporating gamification elements [36]. In order to stimulate the level of student engagement, the researcher proposed the concept of design from the perspective of creating gamified and interactive learning environments, which are applied through the implementation of a design in which learners are motivated and encouraged to set goals for themselves, which ultimately improves the quality and effectiveness of learning outcomes [37]. When compared to traditional courses that are taught using pen and paper, the incorporation of gamification elements into educational settings has the potential to not only enhance the creative abilities and problem-solving skills of students, but also to stimulate enthusiasm and interest, which ultimately leads to an increase in student involvement [38].

3.3.2. Implementation challenges and teaching adjustments

Both methods, gamified teaching and flipped classroom, can enhance student engagement and improve cognition, and gamified teaching is slightly better in these aspects. On the other hand, although gamified teaching has significant advantages in enhancing student engagement and stimulating interest, it also faces the challenge of effectively combining gamified teaching with other teaching modes such as flipped classroom to achieve optimal educational outcomes [39]. Gamification promotes better cooperation and problem-solving skills among students and enhances their perseverance and adaptability. This suggests

that gamification has the potential to help students develop critical thinking skills. However, it also suggests that there is a need to focus on incorporating gamification elements more effectively to promote the overall development of students' abilities. This therefore provides us with new ways of thinking about the challenges of implementing gamified instruction and potential directions for instructional adjustments that are the focus of our attention. This provides educators with valuable insights on integrating and optimizing gamified teaching strategies more effectively while maintaining student engagement and motivation [40].

3.4. Discussion

The analysis and results of the systematic literature review categorize the articles into three directions: teaching implementation and methods, learning outcomes and skill development, and challenges and improvement strategies. Although these directions seem independent, they are interdependent, aligning with the thought process of this study. At this point, these directions can be correlated with the research objectives of this study. Therefore, after analyzing the themes of these literature analysis results, they can be classified into corresponding educational aspects. That is, teaching implementation and methods correspond to teaching strategies and educational methodology, learning outcomes and skill development correspond to learning outcome assessment and student development, and challenges and improvement strategies correspond to educational management and policy formulation. Therefore, these three educational fields are the research objectives of this study: teaching strategies and educational methodology; learning outcome assessment and student development; and educational management and policy formulation. They analyze the development of gamification and its impact on student skills and future development directions from different aspects.

3.4.1. Teaching strategies and educational methodology

Gamified instruction is gradually becoming a creative and effective method in education [41]. In the second part of the 20th century, gamified education became increasingly popular as a method for improving student engagement and interest in the subject matter being taught. Using gamification strategies can potentially increase the motivation of chemistry students in higher education [13]. Using these strategies also has the potential to improve students' attitudes towards learning, attendance and academic performance. More importantly, gamified education can stimulate and sustain students' situational interest, which ultimately increases student engagement and motivation [42].

Gamification, which contains elements such as competition, challenges, tasks, and quick feedback, has been demonstrated to be an extremely effective method for creating learning motivation in students and stimulating active learning and imaginative thinking among them [43]. This is determined by the findings of the research that has been carried out. It has been found that the use of virtual money in computer network courses positively influences student engagement in contrast to non-gamified online activities, which eventually leads to enhanced learning outcomes [44]. This may be attributed to students being more likely to participate in the activities. Not only does this approach make the learning process more interesting and compelling, but it also assists students in acquiring a deeper comprehension of difficult concepts and abilities in an environment conducive to relaxation and happiness [45].

3.4.2. Learning outcome assessment and student development

Implementing gamification in the classroom significantly impacts the improvement of students' skills. The need for students to demonstrate logical reasoning, analytical thinking and creative thinking in completing assignments and puzzles helped them improve their critical thinking and problem solving skills, and they were positively developed [46]. The ability to think critically and solve problems is actively fostered. Additionally, gamified education helps students create a feeling of self-efficacy since it helps them acquire confidence in their ability to complete tasks and discover answers to problems [47]. Because it is feasible that attaining success in games may result in enhanced self-assurance and capacity in real life, gamified education is a helpful instrument for promoting the growth of pupils [48].

3.4.3. Educational management and policy formulation

Policymakers in the education department wishing to achieve the goals of enhancing student motivation, increasing student engagement, and improving the social impact of education can do so by implementing a gamified approach to teaching and learning. Teachers also need to be provided with adequate training and more resources to encourage them to make pedagogical changes and incorporate gamification elements in their teaching practices [49]. In order to meet the individualized learning needs of different groups of students, policymakers need to continuously optimize the educational environment and improve pedagogy so that gamified teaching and learning can be adapted to a diversity of educational environments [50]. Education legislators should focus on the long-term impact of gamified pedagogy on children’s learning outcomes, recognizing that gamified pedagogy has great potential to improve student achievement and

advance educational goals [51]. Gamification of education is a trend that can continuously improve students' academic performance and achieve the sustainable development of their individual abilities.

4. CONCLUSION

A comprehensive review of the relevant literature has shown that gamified teaching has a clear effect on improving students' qualities and skills, that it can be applied in different educational phases and disciplines, and that it has a more significant impact on improving the quality and effectiveness of educational outcomes, and that the way in which it is applied demonstrates diversity and flexibility. However, the implementation of gamified teaching is not without challenges. It requires education administrators and policymakers to consider thoughtfully when integrating game elements with academic content and evaluating and optimizing teaching effectiveness to keep students engaged and motivated while developing their all-round abilities. At the same time, there is insufficient research on gamification in professional education. Gamification teaching strategies have not been popularized in professional education. This can be continued as a research gap. Therefore, gamification teaching gives educators' important insights to optimize teaching strategies and methods. Future research and practice should continue to explore the wide application of gamification teaching to maximize its potential value in modern education.

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