Gamification Applications Trends: A Comprehensive and Systematic Mapping Study

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Abstract

The idea of gamification is rapidly gaining popularity in various sectors, such as e-commerce, health, and education. Analysis indicates that 2021 had the highest volume of published articles, which shows a substantial interest in gamification strategies in the education sector. This interest accounted for 46% of all publications. This study explores publication patterns related to gamification in computer science from 2016 to 2024, using only data from the Scopus database. Conversely, the banking sector showed the lowest participation, with only 6 % of articles on this topic. The increasing utilisation of technology, especially e-learning and educational technology (EdTech), has enhanced the prevalence of gamification in education, fostering cognitive development and promoting student engagement. The findings show the adaptability of gamification as a customisable instrument to achieve certain business objectives across various sectors. This study highlights the need for further research to explore the long-term impact of gamification strategies and their applications in diverse contexts. It highlights the importance of systematic analyses to capture trends and effectiveness in gamification. This research seeks to guide future studies and practical implementations of gamification in computer science and related fields by illuminating the current applications.

Keywords: Gamification, E-learning, Educational Technology, Student Engagement, Cognitive Development, Publication Trends, Computer Science

1.0 Introduction

A new strategy, gamification,has emerged in recent years, revolutionising how consumers engage with content and interact in many contexts. Several articles define gamification as applying game design concepts to non-game contexts to increase user engagement and satisfaction (Lathwesen & Belova, 2021; Yang et al., 2017). The objective is to enhance participation, inspiration, and learning results. This strategy is more important than ever before because the traditional system fails to captivate users in the context of ever-evolving digital environments. Using the inherent incentive in games to encourage desirable actions from users is the core notion behindthe gamification concept, which stems from well-established psychological research. According to (Bouchrika et al., 2021; Cigdem et al., 2024)and (Khaldi et al., 2023), gamification aims to enhance engagement and retention by introducing elements such as leaderboards, challenges, points and badges into otherwise dull tasks. Education, healthcare, e-commerce, banking, and tourism are just a few areas where it has boosted user engagement and motivation (Huang et al., 2020; Pasca et al., 2021).

Regarding businesses, gamification is a game-changer since it improves customer experiences and alters consumers' shopping. By leveraging psychological cues that encourage more frequent brand involvement, gamification can significantly influence the purchasing decisions of customers,

according to research by (Putra Rahmadhan et al., 2023).With so much competition across e-commerce platforms, businesses are using gamification strategies to attract and retain customers. As a technique to Digital marketing, gamification employs game mechanics to pique users' interest and encourages them to take action, which in turn boosts engagement, loyalty, and word-of-mouth promotion. According to research by Putra Rahmadhan et al. (2023), gamification can influence consumers' buying behavior by appealing to psychological factors that lead to more engagement with the business.Because they are so easy to incorporate into everyday interactions, gamified experiences have been increasingly popular in recent years, thanks in part to technological advancements and the broad availability of mobile devices. Scientists have investigated the potential of gamification to boost revenue, customer happiness, and brand loyalty by encouraging positive user behavior.Although gamification has many advantages, the increasing amount of research on the topic shows that it is not easy to adopt and that different gamification tactics have various effects. Numerous Research have shown contradictory findings about the efficacy of different gamification components, making it difficult to understand their individual benefits (Sardi et al., 2017). Therefore, rigorous Studies that chart publishing trends and evaluate gamified approaches' effectiveness in many fields are urgently required.Focusing on the methods, applications, and research evolution of the topic, this systematic mapping study aims to explore publishing patterns associated to gamification. The goal of this research is to synthesize and analyze the current literature on gamification in order to addressthe gaps in our knowledge of the concept.Incorporating game theory into the classroom has the potential to increase student engagement and make learning more exciting (Grabner-Hagen & Kingsley, 2023; Khaldi et al., 2023). Environments may boost the motivation of students, tenacity, and memorization skills, according to research by (Johnson et al., 2016). The broad range of gamification definitions and implementations makes it challenging to establish common criteria for its effective implementation in educational settings (Lampropoulos & Kinshuk, 2024).As a new approach to healthcare, gamification offers the potential to increase patients' compliance with their treatment plans and encourage them to lead healthier lives. (Castellano-Tejedor & Cencerrado, 2024; Gkintoni et al., 2024)found that health apps with game-like features had a higher rate of user engagement, medication adherence, and healthy lifestyle choices. When it comes to gamified health interventions, more systematic studies are required to determine their efficacy in encouraging long-term behavior change andtheir implications (Edwards et al., 2016).Research in the Field of gamification is changing at a breakneck pace as more and more industries utilize gamified strategies to boost user engagement and achieve their goals. This growth, however, highlights the need for systematic reviews that record gamification study publishing trends, topic foci, and methodological diversity (Castillo-Parra et al., 2022; Cavus et al., 2023). This systematic mapping study aims to shed light on the present status of gamification research and guide future paths by offering a thorough literature review.The Literature on gamification will be categorized and analysed in this study using a systematic mapping methodology. This review will focus on consumer Loyalty, engagement, and behavioural consequences linked to gamification in various situations. This Research aims to help researchers, educators, and practitioners successfully apply gamification tactics by thoroughly examining and contributing helpful insights.

2.0 Related Works in Gamification

The learning management system employs gamification to offer immediate data on student achievement, thus promoting collaboration. This study entailed the analysis of gamification literature obtained from the Scopus database. Gamification has been widely adopted in various economic sectors worldwide. (Morschheuser et al., 2018)aimed to establish a thorough process for creating gamified software and to improve comprehension of gamification design. Through engaging in discussions with 25 experts in gamification, a complete collection of design principles for creating gamified software was established. Alhammad and Moreno (2018)

conducted a systematic review to examine the utilisation of gamification in software engineering (SE) education. Their particular focus was on the impact of gamification on software engineering and the accuracy of the claim above in our particular situation. Tobon et al. (2020) comprehensively examined the pertinent scholarly literature on gamification to explore its influence on online consumer choices. The study sought to ascertain the precise elements, procedures, and principles contributing to this impact. Tuah et al. (2021) conducted a study to evaluate the gamification strategies currently used in rehabilitation apps.No text has been provided. A classification system for gamification in rehabilitation is created by considering the necessary elements for rehabilitation gamification and the often-used features of gamification in rehabilitation applications.

Furthermore, (Xu et al., 2023)it developed a theoretical framework to examine the impact of two gamification mechanisms on impulsive buying behaviour during the "Double Eleven" shopping event. A total of 558 valid surveys were obtained from Chinese consumers who utilised either the Taobao or Tmall platforms as part of a conducted survey. Van Roy & Zaman (2018) conducted a study that investigated the fundamental motivating mechanisms of gamification based on the Self-Determination Theory. The researchers analysed the impact of various game design components on motivation, tracked changes in motivation over a while, and examined the potential variations in the motivational impacts of gamification based on individual differences. (Georgiou & Nikolaou, 2020)experimented to determine if job applicants held a more favourable perception of a gamified assessment approach, namely a gamified Situational Judgement Test (SJT), compared to its traditional version, a text-based SJT. The researchers thoroughly analysed current material, focusing on satisfaction, predictive validity, fairness, and the applicant's assessment of the organisation's attractiveness.

(Trinidad et al., 2021)employed bibliometric performance analysis and scientific mapping methodologies to investigate gamification research's intellectual, conceptual, and social network structures. In addition, they researched the area's evolution and dynamic aspects. Bedregal-Alpaca et al. (2020) utilised game mechanics in a study to enhance the acquisition of astronomical knowledge among students in primary education. (Rodrigues et al., 2020) introduced a comprehensive model for incorporating gamification into smart cities, encompassing a mobile application. This application is specifically developed to enhance the quality of public services offered by city hall and foster more excellent connections among individuals. (Knutas et al., 2019)conducted a distinct study that presented a method for tailored content selection using a machine learning algorithm-driven approach. This approach addresses a particular facet of the issue and provides a systematic methodology for creating customised designs, facilitating automation in the implementation phase. This technique is based on Deterding's 2015 paradigm for gameful design, which incorporates the concept of intrinsic skill atoms as a guiding principle.

It includes additional phases for choosing a customisation method and constructing an algorithm. (Aguilar-Cruz & Álvarez Guayara, 2021)examined the students' perception of applying the Serious Game Bethe1Challenge and gamified teaching activities in a high school setting during the pandemic. (Predescu et al., 2021)created a serious game that merges entertainment enjoyment with gamified interaction with the environment. The game also incorporates a crowdsensing element that entails various duties in finding, resolving, and validating water-related issues. (Sudin et al., 2018)created a puzzle app well-suited as a cognitive learning aid since it can engage and inspire users. (Hung, 2017)did a study to enhance face-to-face instruction in flipped classrooms by using clickers. A clicker application was developed utilising a bring-your-own-device (BYOD) strategy to boost classroom dynamics. The application has gaming aspects inspired by question-and-answer competitions. Lathwesen & Belova (2021) thoroughly examined the current body of literature to ascertain if the market for these games has reached its saturation point or if there are still prospects for expansion and progress.

Furthermore, in a recent research study, (Bärnthaler et al., 2021)put out key components for a foundational theory of computation that encompasses the shift from output to social behaviour. The study specifically examines the content and method of computation and the individuals participating in the computation. (Shpakova et al., 2016)specifically examined the use of gamification to enhance collaboration among knowledge workers in commercial applications. We conduct a comprehensive case study to examine how gamification positively impacts knowledge workers and shapes their interactions. To validate our research, (Bahr et al., 2022) investigated the viewpoints of warehouse managers in the United Kingdom regarding the integration of gamification in warehousing operations. The findings indicate that gamification can be successfully employed in warehouse settings, leading to advantages such as heightened worker involvement, higher efficiency and morale, increased competitiveness, improved precision, and skill development. In a study undertaken by (Murillo-Zamorano et al., 2020), the objective was to investigate if crowd-sourced human creativity, implemented through a gamified collaborative design framework, can effectively handle the intricacies of designing predictive environments. (Krath et al., 2021) utilised a qualitative methodology to gather data in a separate study. The central emphasis of the inquiry revolved around the phrase "gamification". According to the results, gamification is widely recognised as a successful teaching method for creating more captivating learning environments. (Kalogiannakis et al., 2021)released a subsequent publication that presents the practical results of their most recent study on the integration of gamification in science education. We performed a methodical examination of 24 empirical research publications published between 2012 and 2020. The publications were obtained from several electronic databases, including the Google Scholar web search engine, which focuses on academic resources and scholarly literature. Mazarakis (2021) conducted a study with 106 experts in gamification who attended four seminars titled "Gam-R — Gamification Reloaded." This leads to the recognition of present and future gamification patterns. In their study, (Prodanova & Van Looy, 2019)examined the progress of utilising social media in business process management. Following a thorough search and careful selection of pertinent publications, a methodical examination of the literature was performed. (Ab. Rahman et al., 2018)utilised gamification in an internet-based setting to augment the promotion and distribution of academic content. Faculty members, students, industry visitors, and the general public were urged to create groups on an Internet platform to promote sharing academic knowledge, goods, and activities. In their 2016 study, Rodrigues et al. investigated the impact of sociality, gamification, and the four defined criteria (usefulness, enjoyment, ease-of-use, and intention to use) on a gamified business application and its connected enterprise. (Doney, 2019)did an extensive study of previous studies to determine the essential methods and pedagogical components that enhance the effectiveness and engagement of gamification in e-learning activities, specifically for adult learners. The objective was to create a comprehensive list of attributes that can be used as principles for integrating gamification elements into e-learning.Alsawaier (2019) examined the research design of several articles on gamification. The study proposes employing a mixed-method research methodology to comprehend gamification phenomena fully. Salimon et al. (2021) have found that using gamification, hedonic incentives, and cultural factors may impact the acceptance of smartphone banking. (Lee et al., 2024)conducted a study on an online game created for museum usage. The game aims to promote user engagement with artworks in a collection through an enjoyable and engaging experience.Additionally, it seeks to collect user opinions on the resemblance between various artworks. This input is highly important for curators as it allows them to reassess the organisation of digital exhibitions and obtain profound insights into visitors' perceptions of artworks. (Yazdi et al., 2024)conducted a study utilising bibliometric, social network, and text mining analysis to provide up-to-date and thorough insights into gamification. (Lu et al., 2020)presented TouristGo, a smartphone game designed to incentivise travellers to choose the

least crowded route. In addition, the game gathers the geographical data of visitors to enhance the administration of tourist movement in cultural heritage regions. (Portela, 2023)clarified the methodology used to implement this paradigm in a real-world context, provided students' viewpoints, and assessed the achieved results. (Henderi et al., 2020)examined the lecturer's failure to promptly provide test scores using the view board method within the gamification framework. Combining board games and gamification can provide successful solutions in the realm of technology literature in the millennial era.

3.0 Research Method

A systematic Mapping study (SMS) is a secondary training that seeks to categorise and evaluate prior research subjects (MAREW et al. 2007). This part provides a concise overview of the methods we utilised. Although SMS is commonly linked to systematic literature review (SLR), which seeks to gather and assess all the research findings on a particular topic, it should be noted that this approach differs from SLR (Knutas et al., 2019).

3.1 Data Collection Process

This study collected empirical, qualitative, and quantitative literature from multiple reputable digital collections, including Scopus, Web of Science, IEEE Xplore, and Google Scholar. Various search queries were employed across these platforms to locate relevant documents, which were subsequently scrutinized for their contributions to the field. The publishers whose papers were reviewed include Elsevier, Springer, Taylor & Francis, Wiley, the Association for Computing Machinery (ACM), and the Institute of Electrical and Electronics Engineers (IEEE). Our search strategy specifically targeted the mapping of journals in computer science (CS) from 2016 to 2024. By utilizing the Boolean operator "AND" across these databases, the inquiry yielded a total of thirty-three (33) publications that integrate computer science and gamification. ACM and IEEE remain prominent journals in this field. Table 1 displays the publishing houses along with the corresponding documents identified during the review.

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Table 1: Publishing firms and papers retrieved

Publisher	Retrieved Papers
Association for Computing Machinery	4
Springer Science and Business Media B.V.	4
MDPI	4
Taylor and Francis Ltd.	2
Elsevier Ltd	5
Google Scholar	6
Web of Science	5
John Wiley and Sons Inc	2
IEEE Computer Society	6
Inderscience	2
Others	4
Total	**44**

The search string used for our study is provided below;

TITLE-ABS-KEY((GAMIFICATION TRENDS)) AND (LIMIT-TO (PUBSTAGE,"final")) AND (LIMIT-TO (PUBYEAR,2022) OR LIMIT-TO (PUBYEAR,2021) OR LIMIT-TO (PUBYEAR,2020) OR LIMIT-TO (PUBYEAR,2019) OR LIMIT-TO (PUBYEAR,2018) OR LIMIT-TO (PUBYEAR,2017) OR LIMIT-TO (PUBYEAR,2016)) AND (LIMIT-TO (DOCTYPE,"ar")) AND (LIMIT-TO (SUBJAREA,"COMP")) AND (LIMIT-TO (EXACTKEYWORD,"Gamification")) AND (LIMIT-TO (LANGUAGE,"English")) AND (LIMIT-TO (SRCTYPE,"j"))

3.2 Inclusion and Exclusion Criteria

Our search term turned up 56 journal articles during the database searches. The titles, keywords, and abstracts of these papers were examined first. Articles written in languages other than English that did not address gamification were removed from the study during the initial round of review. Forty-nine articles made it through the initial round to be thoroughly examined and compared to the inclusion and exclusion criteria. The inclusion and exclusion standards listed below were applied to the remaining articles. Discussion of the following subjects was one of the study's inclusion requirements:

• The utilization of gamification in computer science across several application domains, including education and banking.

• The significance of gamification in general search engine queries, supported by papers from Scopus databases and peer-reviewed sources.

The papers did not include the following categories:

• Literature surveys lacking original research (study reports),

• Papers written in languages other than English,

• Papers not subjected to peer review, or

• Papers that do not approach the subject topic from the gamification and computer science perspective.

Any papers that did not fulfil our established criteria were eliminated. After the last filtering stage, 44 articles were selected for the systematic literature review.

Focusing on the computer science subject area.

The comma-separated value (CSV) file was extracted from the Scopus database, which gave us the list of publishers, publication year, authors, etc.

3.3 Target Research and Objectives

This paper seeks to answer questions related to our topic, specifically gamification in computer science. The following inquiries were addressed: 1) How is gamification being discussed in computer science publications recently? field of computer science?2) Where does gamification fit within the field of computer science? headed in the field of computer science?

The final 33 journal articles were used in this present study.

4.0 Results and Discussion

This section focuses on the outcomes of the ultimate scholarly publications and the precise objectives this work aims to accomplish. The first subsection examines the publication trend in gamification in computer science. The document's second section outlines the specific domains in computer science where gamification is applied. The third section discusses the effects and consequences of gamification in computer science. The fourth segment also analyzes the future trend of gamification in computer science. Lastly, the study's constraints are outlined.

4.1 Publication Trend of gamification in Computer Science

This study looked at journal articles published between 2016 and 2024 from the Scopus database. The publication trend by year is represented in Figure 1 below;

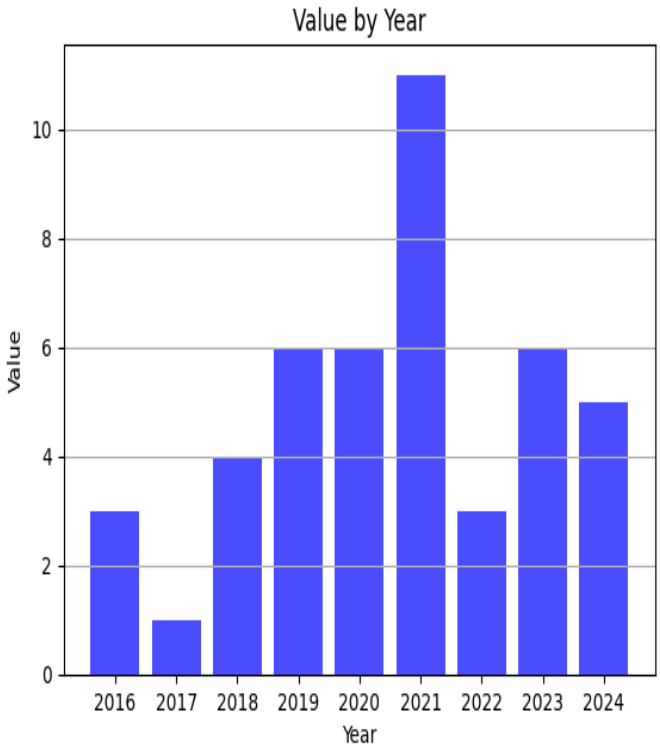

Figure 1: Publication by year

Figure 1 presents the publication year and their corresponding values (number of publications). The highest number of publications were recorded in 2021 with eleven, next in 2019 with ten, and in 2020and 2023 with six each. In 2017, there was only one publication recorded. In 2021, the Term ***gamification***made its debut in academic computer science journals. There was a period of exponential growth from 2018 to 2021 as at the time this report was written, five (5) publications had been published in 2024. The number could be increased since the year is still young and has yet to end. It is hoped that researchers will publish in this area, thus, gamification.

4.2 Application Areas of Gamification in Computer Science

The final forty-four (44) papers were subject to studying the area of application in which gamification has been applied. Figure 2 below

discusses the application areas in which gamification has been applied in computer science.

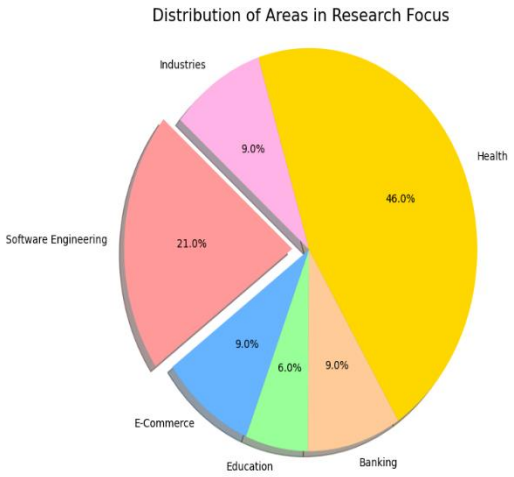

Figure 2: Application areas of gamification

Figure 2 above shows that the most applied area of gamification is in the education sector, which represents 46% (15 out of the 33) journals used in this study. The industries (manufacturing, production, mining, etc.) are the second highest, with 21% (7 out of 33) of the journals used in this study. The software, e-commerce, and health industries recorded 9% (3 out of 33) each in the studied journals. The lowest was the banking industry, with 6% (2 out of 33) of the journal. It is seen that the education sector attracts a lot of gamification applications. Thus, gamification in education helps students understand the subjects they are taught (van Roy & Zaman, 2018).

4.3 Impacts of Gamification in Computer Science on the Application Area

Educational research in particular has benefited greatly from gamification's use, which has increased both learning outcomes and engagement. Electronic learning, or e-learning, has become more popular as a means for educational institutions to improve their teaching methods due to the advancements in technology. of the recent COVID-19 outbreak, a number of educational institutions have started using online learning platforms like Zoom and Tencent.The need for creative solutions to keep students interested in virtual environments has been brought to light by this change.E-learning encompasses various challenges, including feelings of tension and dizziness experienced by learners due to prolonged screen time and the lack of interactive elements (Tang et al., 2020). One Important approach to these problems is gamification, which involves adding game mechanics to educational frameworks in order to increase student engagement and motivation. The Power to make boring things fun again is at the heart of gamification, which aims to keep participants (such as students and workers) awake and focused through game-like interactionsand exercises. (Bedregal-Alpaca et al., 2020) define gamification as a methodological approach that incorporates participatory tactics with electronic devices to create immersive and playful learning environments. Their findings highlight the importance of gamification in educational initiatives that target elementary school kids' comprehension of difficult topics like astronomy. The study found that learners are motivated and feel a feeling of accomplishment when they work through problems in gamified applications and earn incentives. Students' ability to think critically and solve problems, as well as their knowledge retention, are both improved by this method. Furthermore, gamification isn't just for schools anymore; it's now used in healthcare, business, and even software engineering. One Industry that has used gamification to great effect is healthcare, namely in the area of encouraging healthy behaviors among patients. Researchers found that by offering instant feedback and incentives, gamification techniques increased participation in health-related activities (Deterding et al., 2011). Companies in the corporate world have started using gamification strategies to boost morale and output from their staff. Gamified training programs have been used by companies such as Deloitte and Microsoft to promote collaboration and teamwork while also improving skill development (Werbach & Hunter, 2012). Research into software development has demonstrated that gamification can increase engagement and satisfaction among users. Gamified systems can boost user engagement and happiness, which in turn improves retention rates, according to research (Hamari et al., 2014). This is especially important in the field of educational apps and software, where active participation from users is key to successful learning results. Research

methodology is another area where gamification has had an impression. In order to gain real-time insights into user behavior and engagement, gamification offers a novel method of data collecting and analysis. Gamification allows researchers to increase participant engagement and collect more detailed data from experiments (Kapp, 2012). The Use of gamification into research techniques has the potential to produce more interesting and effective studies, highlighting the wide range of domains in which gamification may be applied.

4.4 Discussion

Improving learning results and student engagement are the goals of gamification when used in educational settings. After consulting with 25 gamification design professionals, (Dicheva et al., 2015)laid out a method for methodologically making gamified software. Their work resulted in a comprehensive collection of design principles, providing a foundational framework that informs the development of effective gamified educational tools. The need for aligning educational objectives with gamified aspects is highlighted by this systematic approach, which is crucial for ensuring that gamification tactics are both engaging and pedagogically sound. One systematic evaluation that looked at the use of gamification in software engineering courses found that it improved students' learning experiences (Alhammad & Moreno, 2018). Their findings emphasize that tailored gamification approaches can enhance engagement, improve retention, and promote collaborative learning among students. This exemplifies how gamification can be used in various fields and how it may encourage creative approaches to education. Also seeking to discover particular components and concepts that contribute to the efficacy of gamification, (Tobon et al., 2020) investigated its impact on online customer choices.Their findings suggest that gamification significantly enhances user interaction, leading to better decision-making. The dual application of gamification in educational and consumer contexts illustrates its versatility, reinforcing the argument that game elements can effectively motivate users across different environments. Classification system for effective rehabilitation gamification was developed based on an evaluation of gamification tactics in rehabilitation apps (Tuah et al., 2021). Their studies highlight the positive effects of gamified methods on patient adherence to rehabilitation programs and health outcomes. Motivation is key, this study's findings about gamification's ability to connect user engagement with health-related behavior change are quite pertinent. The study has focused on the potential of gamification to increase user engagement and revenue in online retail settings. The Impact of gamification in enhancing user engagement on e-commerce platforms was examined by (García-Jurado et al., 2021),who aimed to solve the difficulties encountered by online retailers when trying to engage people without prior expertise. Analyzing data from 253 Spanish Amazon users using structural equation modeling, they validated the User Engagement Scale (UES) and demonstrated that gamification significantly boosts user interaction. This study not only reinforces the positive impact of gamification on engagement but also introduces a five-factor model of UES, offering practical insights for marketers aiming to improve customer retention and product reviews. (Aparicio et al., 2021)further underscore the significance of gamification in e-commerce by illustrating how integrating game-like elements can enhance user engagement and drive repurchase intentions. They emphasize the importance of platform reputation in fostering consumer trust, which is foundational for creating immersive shopping experiences. Their findings reveal that specific gamification elements, such as points and rewards, enhance user satisfaction, indicating that e-commerce businesses should strategically incorporate gamification to boost user loyalty. (Hermawan & Tjhin, 2023)focus on the Indonesian market, particularly the Shopee platform, examining the impact of gamification on customer engagement. Their research identifies four dimensions of customer engagement—customer lifetime value, referral value, influence value, and knowledge value. Findings indicate that gamification positively influences all four dimensions, particularly customer influence and knowledge value. The Significance of social connection, rewards, and progress monitoring as essential gamification features that boost engagement is emphasized by

this study.The Use of gamification in wellness and health settings has been growing, especially for the purpose of motivating positive lifestyle choices. According to (Hu et al., 2022), researchers look at how gamifying SLSS affects the gifting habits of users.They find that SLSS utilizes game-like design elements to enhance user engagement and facilitate gifting as a transactional process within e-commerce. Gamification has a substantial impact on user motivations, according to the study, with intrinsic rather than extrinsic factors driving gifting behavior. In order to create successful gamification tactics for health-related settings, it is crucial to understand user motivations. During the COVID-19 pandemic, gamification was used to increase brand engagement and self-brand relationships (Arifah, 2022).Through a quantitative study involving 250 frequent e-commerce users, the research finds significant positive correlations between gameful experiences and self-brand connections, mediated by brand engagement. This shows that the ability gamification to build cognitive and emotional connections with businesses through the creation of interesting, interactive experiences can successfully tackle issues like banner blindness and consumer avoidance of traditional marketing. One study that looked at the impact of gamification on online shopping, compared the relative merits of monetary and non-monetary incentives (Meder et al., 2018). Their research, conducted with 20,000 participants using a mobile application, demonstrates that gamification significantly enhances user engagement, with tangible rewards leading to a substantial increase in user activity compared to intangible rewards. However, they also note a slight decrease in engagement over time, indicating that users might overlook content in pursuit of rewards. This finding suggests the importance of carefully designing reward systems to sustain user interest over time.While the positive aspects of gamification are widely recognized, several studies address its potential negative impacts. (Almeida et al., 2023)explore the adverse effects of gamification in education, conducting a systematic mapping study that identifies 87 papers discussing undesired impacts of game design elements. Their findings indicate that elements such as badges, leaderboards, and points can lead to motivational issues, decreased performance, and ethical dilemmas such as cheating. This highlights a critical gap in awareness among software developers regarding these adverse effects, emphasizing the need for greater scrutiny of gamification practices to mitigate harmful consequences. (Hellberg & Moll, 2023)similarly review the negative effects of gamification in digital education, categorizing these impacts into distinct groups that affect student engagement, motivation, and learning performance. Their rigorous analysis of existing literature aims to inform educators and designers about the nuanced impacts of gamification, advocating for a balanced approach that recognizes both its benefits and potential drawbacks. (Toda et al., 2018)systematically map the negative impacts of gamification in educational contexts, identifying four main negative effects: Loss of Performance, Undesired Behavior, Indifference, and Declining Effects. They emphasize that Loss of Performance is frequently reported, often linked to competitive elements like leaderboards that may foster unhealthy competition among students. Their findings reveal that many educators overlook these potential negative outcomes, focusing instead on the motivational benefits of gamification. This calls for careful design and implementation of gamified elements to create more effective and supportive learning environments.

4.4 Future Trend of Gamification in Computer Science

Our investigation aligns with the findings of Kasurinen & Knutas (2018) and Arroyo (2016), revealing a strong trend among researchers focusing on the incorporation of gamified applications into education, including eLearning and other technological advancements within the Educational Technology (EdTech) sector. Gamification represents the future direction of innovation in this field. According to data from Scopus, current trends in gamification research primarily concentrate on developing proof-of-concept systems, particularly within eLearning applications. As gamification continues to evolve, future research should explore its applications across diverse contexts and its long-term impacts. Chugh and Turnbull (2023) conducted a

bibliometric analysis of 3,617 publications, identifying key themes such as mobile gaming, health and medicine, and teacher adoption. Their findings suggest that customized gaming applications tailored to specific learning goals can significantly enhance student motivation and learning outcomes, reflecting a growing trend towards innovative teaching methods. Furthermore, Krishnamurthy et al. (2022) emphasize the increasing integration of gamified platforms—such as educational games and mobile apps—into medical curricula, highlighting their benefits in improving learning outcomes and engagement. This shows the emergence of gamification as a vital component of modern education, responding effectively to students' technological literacy and desire for diverse learning experiences. In addition, Zhao (2022) explores gamification incentive mechanisms in e-commerce platforms, emphasizing their role in enhancing user engagement. The study identifies key dimensions of gamification incentives, including the richness of symbols, the enjoyment of gamification, the contagiousness of social interactions, and the seduction of achievement. Collectively, these elements influence consumer attitudes and willingness to engage with e-commerce platforms, addressing a significant gap in the literature on gamification in marketing contexts.

4.5 Limitations

The scope of our study is restricted to the implementation of gamification specifically within the field of computer science and information technology applications. We restricted our search just to the Scopus database and did not include non-Scopus databases. Furthermore, the year's duration extended over nine (9) years, specifically from 2016 to 2024. Moreover, we performed a Short Message Service (SMS) analysis on our data instead of a Systematic Literature Review (SLR), as they have different purposes and are not interchangeable.

5.0 Conclusion

Across many different industries, gamification has become a major trend in the creation of new services and apps. Businesses may increase user engagement with both staff and customers by using game mechanics in non-game settings. Gamification is a flexible strategy for increasing engagement and involvement since it can be tailored to match the unique requirements of a company. This personalization serves to enhance the user experience while simultaneously supporting the goals of gamification, cultivating an environment that encourages motivation and productivity.The capacity for gamification to integrate feedback from both users and organizations is particularly beneficial.It enables the gamified experience to be enhanced continuously, guaranteeing its continued relevance and efficacy. Gamification offers a captivating solution that can be customized to match varied contexts, including education, healthcare, marketing, and finance, as organizations search for novel ways to engage their stakeholders. The study analyzed a range of computer science articles focusing on gamification as a subject matter expert system. By addressing four distinct research questions, this effort sheds light on the evolving landscape of gamification in various fields. Experts in the field of computer science are known to regularly release studies exploring the potential benefits of gamification in the classroom. With an emphasis on educational settings, gamified tactics have the ability to create a more engaging learning atmosphere, increase student engagement, and improve learning results. Educators may make their lessons more engaging, thought-provoking, and collaborative for students by including gamification elements. The usefulness of gamified applications is being recognized by more and more sectors outside of education. To improve decision-making, involve stakeholders, and draw in customers, businesses are using gamification. For Instance, budgeting apps in the financial industry can incorporate gamified components to encourage users to save and improve their financial management skills. In the healthcare industry, gamification can be used to motivate patients to follow their treatment programs or adopt good habits by offering rewards for activities completed or health milestones achieved. According to the current trend in technology, gamification will be highly beneficial when applied to many businesses. In response to the new threats posed by the COVID-19 pandemic, several institutions in the fields of

education, healthcare, and finance have turned to technology. Organizations must Seek out inventive ways to keep people engaged and connected as the pandemic hastened the transition to digital platforms. By creating a sense of belonging and achievement, gamification is one strategy that could change the way people shop, work, and study. Using both intrinsic and extrinsic motivators, gamification is able to influence behavior effectively. Organizations can promote deeper user engagement with their content or services by establishing competitive settings with elements like points, badges, and leaderboards. According to studies, gamified experiences can boost user engagement, which in turn improves performance and satisfaction.

5.1 Future Works

We intend to increase the number of years covered and the number of databases included in future studies; these will include Scopus, Web of Science, and IEEE, among others. value of interdisciplinary approaches, even if our present analysis was mostly focused on computer science. We can grasp the full scope of gamification's effects across industries, we will also investigate allied fields like engineering and agriculture. With this growth, we can collect a more comprehensive dataset and compare different industries, bringing attention to the specific uses and results of gamification in each field. We will find new trends and best practices that can make gamification efforts more effective by combining insights from other fields. Research will also investigate how gamification impacts user engagement and learning results over the long run, which will be useful for both academics and professionals in the field. Our goal is to addto what is already known about gamification and its many uses by carrying out these initiatives.

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