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Unleashing gamification: a systematic review in primary schools

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ABSTRACT

The implementation of gamification in primary education has garnered significant attention for its potential to enhance learning experiences and outcomes. This systematic review examines the integration of gamification across various subjects in primary education from 2022 to 2024, focusing on the types of strategies employed and their impacts. By analyzing 27 studies selected through the preferred reporting items for systematic reviews and meta-analyses (PRISMA) framework, this review reveals that gamification is widely applied in subjects such as language learning, mathematics, science, and many topics utilizing both digital and non-digital approaches. The findings indicate improvements in academic performance, motivation, engagement, and skill development. However, gaps remain in understanding the long-term effects, impacts on different learning styles, and potential negative consequences. Future research should explore these areas through longitudinal studies and the integration of emerging technologies in gamified learning environment.

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1. INTRODUCTION

The rise of the digital age has completely transformed educational methods, with gamification emerging as a powerful tool to improve learning experiences. Gamification, which involves applying game design elements and principles to non-game settings, has gained considerable popularity in educational environments, particularly in primary education [1], [2]. As the foundation for lifelong learning, primary education stands to benefit greatly from gamification's unique ability to engage young learners and foster critical skill development [3], [4]. The extensive implementation of gamification strategies in primary schools on a global scale underscores its ability to greatly boost motivation, involvement, and educational achievements across a wide range of subjects [5], [6]. Yet, introducing gamification in primary education brings forth opportunities and challenges. It requires a deep comprehension of its theoretical basis, practical uses, and possible outcomes.

The theoretical foundation of gamification in education is rooted in well-established learning theories that emphasize active participation, experiential learning, and intrinsic motivation. Constructivist approaches, as proposed by Piaget [7] and Wahid and Ain [8], align closely with gamification principles by emphasizing learner-centered, experiential knowledge construction. Kolb [9] further supports gamification by highlighting the importance of concrete experiences and reflective observation in the learning process. Motivation theories, particularly self-determination theory by Deci and Ryan [10] elucidate how gamification can enhance intrinsic motivation through elements of autonomy, competence, and relatedness. The attention, relevance, confidence, and satisfaction (ARCS) model of motivational design [11] offers a framework for creating engaging gamified learning experiences by addressing ARCS. Additionally, flow theory by Nakamura and Csikszentmihalyi [12]

explains how gamification has the potential to improve learning experiences by finding the right balance between challenge and skill levels, ensuring that learners remain engaged and motivated throughout the educational process.

Gamification in primary education encompasses various strategies and applications tailored to young learners' developmental needs. Common gamification elements include points [13], badges [14], leaderboards [15], progress bars [16], avatars [17], and narrative-based challenges [18], [19]. These elements are seamlessly integrated into learning activities to create engaging, goal-oriented experiences that promote active participation and sustained motivation. In mathematics education, for instance, gamified approaches have demonstrated improvements in problem-solving skills and attitudes towards the subject [20], [21]. Digital math games incorporating adaptive difficulty levels and immediate feedback have positively affected arithmetic skills and mathematical reasoning [22], [23]. Language learning has also benefited from gamification with studies reporting increased vocabulary acquisition and reading comprehension through gamified activities [24], [25]. Science education has embraced gamification to make abstract concepts more tangible and engaging, utilizing virtual laboratories, augmented reality (AR) applications, and simulation games to enhance scientific inquiry skills and conceptual understanding [26], [27]. Narrative-driven games and role-playing elements in social studies and history have been employed to immerse students in historical contexts and develop critical thinking skills [28], [29].

The impacts of gamification in primary education are multifaceted, encompassing cognitive, affective, and social dimensions. Numerous studies have shown that primary school students exposed to gamified learning environments experience improvements in academic performance, problem-solving skills, and knowledge retention [30], [31]. Affective outcomes associated with gamification include increased motivation, engagement, and positive attitudes toward learning [32]–[34]. Socially, gamification has enhanced collaboration skills [35], peer learning [36], and classroom dynamics [37]. Gamified group activities and competitive-collaborative games have fostered teamwork [38] and communication skills among primary school students [39]. Despite its many benefits, incorporating gamification also comes with its fair share of challenges. Educators and researchers must be mindful of the risk of fostering extrinsic rather than intrinsic motivation, potential distractions from learning objectives, and issues of equity in access to technology [40], [41]. Designing age-appropriate gamified content that aligns with curriculum standards requires careful consideration and expertise [42], [43].

One significant gap is the lack of detailed exploration into which subjects or any specific topics benefit most from gamification [43], [44]. Studies have explored incorporating gamification into mathematics, language learning, and science. However, there remains a lack of clarity on which gamified methods best improve these subjects or any other topics. Moreover, it is essential to understand the varied gamification types and their distinct effects on educational results in different subjects. The main goal of this systematic review is to fill in these gaps by conducting a thorough analysis of the recent incorporation of gamification in primary education. The review will examine the most frequently studied topics, explore the different types of gamifications, and assess their impacts, as depicted in Figure 1.

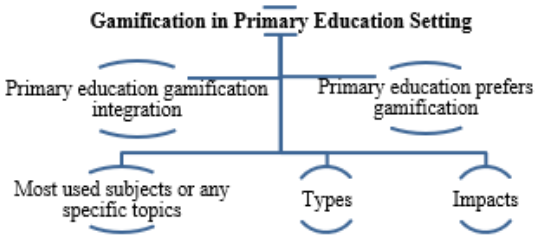

Figure 1. The topic of studies involving gamification in primary education and its integration

2. METHOD

2.1. Research design

This study adheres to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) framework by Moher *et al*. [45], a methodologically robust and widely recognized approach for conducting systematic reviews with transparency and rigor [46]. The PRISMA framework encompasses four essential steps: identification, screening, eligibility, and inclusion, which collectively ensure a comprehensive review process [47]. Figure 2 visually represents how this framework was utilized in the present study. It illustrates the systematic approach that was employed in the process of selecting and analyzing the literature [48].

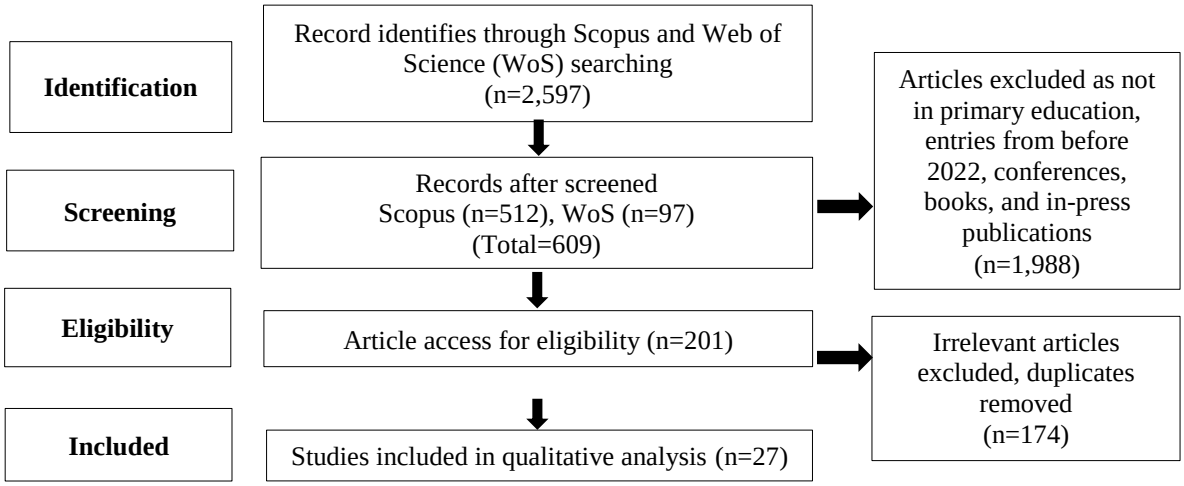

Figure 2. Diagram of the search strategy for the planned study [45]

2.2. Identification

The initial step involved a comprehensive literature search in the Scopus and WoS databases. This search yielded a total of 2,135 records from Scopus and 462 from WoS, resulting in a combined dataset of 2,597 records. The search strategy was carefully designed to capture a wide range of studies on gamification in primary education. Keywords were selected to align with the study's focus, using Boolean operators such as "Gamification OR game-based learning AND primary school" and "Gamification AND primary school NOT game-based learning" (to exclude "game-based learning"). Additionally, wildcards like 'gam* AND primary school*' were employed to include variations such as 'game', 'gamification', and 'gamified'.

2.3. Screening

During the screening phase, the initial pool of records was filtered according to predefined inclusion and exclusion criteria. These criteria included the removal of non-English articles, those published before 2022, as well as conference papers, book chapters, and articles that still in press. Following this rigorous screening, 1,988 records were excluded leaving 609 articles (512 from Scopus and 97 from WoS) for further evaluation.

2.4. Eligibility

In the eligibility phase, the remaining 609 articles were subjected to a more detailed review to assess their relevance to the study's objectives. Articles were scrutinized based on their focus on gamification in primary education, particularly their examination of the subjects and topics where gamification is applied, the types of gamification strategies used, and the impacts on student outcomes. This phase resulted in the exclusion of 201 articles that did not meet the criteria, reducing the number of eligible articles to 175.

2.5. Inclusion

The final step of the PRISMA process involved the inclusion of articles that passed the eligibility check. After a comprehensive review, 27 studies were selected for qualitative analysis. These studies were chosen based on their relevance, quality, and contribution to the understanding of how gamification is integrated into primary education focusing on subjects or specific topics, the types, and impacts.

2.6. Synthesis and quality appraisal

The synthesis process included systematically extracting and categorizing data from the 27 studies. The extracted data focused on identifying the subjects where gamification is integrated, the types of gamification strategies employed, and the resulting impacts. This process was guided by the study's objectives, ensuring that the synthesis was aligned to provide a comprehensive understanding of gamification in primary education [49]. The evaluation of quality was done utilizing the critical appraisal skills programme (CASP) checklist, as illustrated in Table 1. This checklist is specifically designed to appraise the methodological quality of studies included in systematic reviews [50]. The evaluation encompassed various factors, including the clarity of the research inquiries, the suitability of the research design, and the strength of the data collection and analysis methods all assessed by well-qualified experts in the field of education. This study meticulously assessed each of the 27 studies to guarantee the inclusion of only high-quality ones in the final analysis. This meticulous process bolstered the validity and dependability of the review's findings.

Table 1. Quality assessment overview

Evaluation criteria	Affirmative responses					Negative responses					Consensus rate (%)	Remarks
	E1	E2	E3	E4	E5	E1	E2	E3	E4	E5		
Part A: validity of outcomes												
1. Clarity of research objectives	✓	✓	✓	✓	✓						100	Outstanding
2. Suitability of methodological approach	✓	✓	✓	✓	✓						100	Outstanding
3. Alignment of research design with objectives	✓	✓	✓	✓	✓						100	Outstanding
4. Appropriateness of participant selection method	✓	✓	✓	✓	✓						100	Outstanding
5. Relevance of data collection methods	✓	✓	✓	✓	✓						100	Outstanding
Part B: outcome evaluation												
1. Thoroughness of data analysis	✓	✓	✓	✓	✓						100	Outstanding
2. Precision in presenting findings	✓	✓	✓	✓	✓						100	Outstanding
Part C: research significance												
1. Overall research impact	✓	✓	✓	✓	✓						100	Outstanding

Note: E1-E5 represent individual experts

2.7. Data extraction and analysis

All included studies were systematically cataloged for data extraction with key details such as authors, publication year, research design, and findings recorded in an Excel spreadsheet. This systematic approach facilitated the identification of integration in topic studies, types, and impacts of gamification. The analysis involved summarizing the key findings and organizing the data into meaningful parts, highlighting how gamification is implemented in primary education from top tiers journal (Table 2).

Table 2. Finding 27 articles from the Scopus and WoS databases

No.	Reference	Journal	Country	Method
1	[51]	Revista de Linguistica y Lenguas Aplicadas	Chile	Quasi-experimental
2	[52]	Education Sciences	Spain	Quasi-experimental
3	[53]	Sustainability	Hong Kong	Quasi-experimental
4	[54]	Sustainability	Colombia	Case study
5	[55]	Simulation & Gaming	Egypt	Action research field experiment
6	[56]	Education Sciences	Israel	Quantitative
7	[57]	International Journal of Information and Education Technology	Peru	Mixed-method
8	[58]	Edutec	Spain	Mixed methods
9	[59]	Computer Applications in Engineering Education	Spain	Experimental
10	[60]	Infinity Journal	Malaysia	Quasi-experimental
11	[61]	Frontiers in Education	Kazakhstan	Experimental
12	[62]	Education Sciences	Spain	Quasi-experimental
13	[63]	Computer Applications in Engineering Education	Portugal	Meta-analysis
14	[64]	European Physical Education Review	Spain	Mixed-method
15	[65]	Sustainability	Spain	Mixed-method intervention study
16	[66]	Education and Information Technologies	Spain	Mixed methods
17	[67]	European Journal of Geography	Slovenia	Quantitative
18	[68]	Scientific Technical Journal of School Sport, Physical Education and Psychomotricity	Spain	Questionnaire and assessment
19	[69]	International Journal of Special Education	Indonesia	Qualitative
20	[70]	Education Sciences	Greece	Questionnaire
21	[71]	Forum for Linguistic Studies	Saudi Arabia	Quasi-experimental
22	[72]	International Journal of Information and Education Technology	Peru	Questionnaire and assessment rubric
23	[73]	Aula Encuentro	Spain	Case study
24	[74]	Journal of Information Technology Education: Research	Philippines	Quantitative approach
25	[75]	International Journal of Engineering Pedagogy	Slovakia	Case study
26	[76]	Journal of Research in Mathematics Education	Spain	Systematic review
27	[77]	International Journal of Child-Computer Interaction	Italy	Comparative study

3. RESULTS AND DISCUSSION

3.1. The integration of gamification

The integration of gamification in primary education spans a diverse range of subjects and many topics, demonstrating its versatility as a pedagogical approach. In language learning, several studies have explored innovative applications. Cancino and Viguera [51] utilized Kahoot! for English vocabulary instruction, while Casanova-Mata [52] employed an ‘among us’ game-based approach for English as a second language. Li *et al.* [53] developed a gamified e-learning system for L2 English acquisition, while Peláez and Solano [54] created a multimedia experience called coco-shapes for teaching English language concepts. In science education,

gamification has been applied to various topics. Mohammed *et al.* [55] focused on the circulatory system, Rayan and Watted [56] used Kahoot! for general science instruction and Ccoa *et al.* [57] employed Quizizz in natural sciences. Bilbao-Aiastu and Miranda-Urquij [58] integrated gamification in teaching renewable energies. Mathematics education has also seen significant gamification efforts. Puig *et al.* [59] developed digital gamified activities for geometry and Setambah *et al.* [60] applied non-digital gamification to teach fractions. In technology and computer science, Kaldarova *et al.* [61] used game-based learning for computer science terminology, Olmo-Muñoz *et al.* [62] applied gamification to computational thinking, and Costa [63] explored its use in programming instruction. Physical education has been addressed by Sotos-Martínez *et al.* [64] and Fernández-Vázquez *et al.* [65] both implementing gamified approaches in this area.

Beyond traditional subjects, gamification has been integrated into more specialized areas of primary education. Sipone *et al*. [66] and Rogelj *et al*. [67] applied gamification to teach sustainable mobility concepts, highlighting this approach's potential to address contemporary societal issues. Piñeiro [68] used an indoor-outdoor gamified approach for health education. Kusmawati *et al*. [69] explored the use of gamification media for students with attention-deficit/hyperactivity disorder (ADHD), demonstrating its potential in special education contexts. Some studies focused on broader applications across multiple subjects, such as Balaskas *et al*. [70] using Kahoot! across various subjects, Ali *et al*. [71] explored student preferences for gamified activities in general, and Maraza-Quispe *et al*. [72] compared Kahoot and Quizizz for providing feedback across different subjects. Santurio [73] took a unique approach by using a Harry Potter-themed gamification across general subjects. Abenes *et al*. [74] focused specifically on physics instruction using a gamified mobile app. Valentová and Brečka [75] analyzed digital games for primary-level technical education, broadening the scope of gamification in technology education. Caballero [76] explored digital technology-based gamification in mathematics. In literacy education, Cattoni *et al*. [77] incorporated gamification into reading and writing instruction.

3.2. The types of gamifications

Various forms of gamification employed in primary education involve a diverse array of game elements and mechanics. Digital platforms and tools are prominently featured in many studies. For instance, Kahoot!, is a popular quiz-based platform that integrates elements of competition, time pressure, and immediate feedback [51], [56], [70]. Similarly, Quizizz is another quiz-based tool that enhances learning with self-paced elements and personalized reviews [57], [72]. Both platforms often include leaderboards, points, and badges as reward systems. Li *et al*. [64] developed more comprehensive gamified systems for English learning and Abenes *et al*. [74] for physics, incorporating multiple game elements into custom-designed applications. Casanova-Mata [52] took a unique approach by adapting the popular game *Among Us*, leveraging its elements of mystery and collaboration for language learning. Additionally, Peláez and Solano [54] with Coco-Shapes and Puig *et al*. [59] in geometry activities represent custom-designed gamified experiences tailored to specific learning objectives likely incorporating progressive challenges and virtual rewards.

Non-digital gamification approaches are also prevalent, often focusing on role-play, quests, and physical activities. For example, Harry Potter-themed gamification likely incorporated elements of storytelling, character roles, and quest-like challenges [73]. Setambah *et al*. [60] used non-digital gamification for teaching fractions, possibly employing physical manipulatives and game-like rule structures. Indoor-outdoor gamified approaches were applied for sustainable mobility and health education, respectively, suggesting the use of physical quests or challenges [67], [68]. Virtual reality (VR) was combined with gamification in physical education, blending digital and physical game elements [65]. Additionally, physical education was gamified using elements like points, challenges, and team competitions [64]. ClassCraft, a platform that transforms the classroom into a role-playing game, was utilized, incorporating elements like character development and team quests [66]. Ali *et al*. [71] incorporated interactive challenges, digital libraries, and point-based rewards, transforming reading into compelling adventures that students eagerly pursued. Several other studies, while not specifying particular game elements, likely employed a combination of points, badges, leaderboards, challenges, and narrative elements in their gamified approaches [55], [58], [61]–[63], [69], [75]–[77]. This diversity in gamification types reflects the flexibility and adaptability of gamification in addressing various educational needs and objectives.

3.3. The impacts of gamification

The impacts of gamification in primary education are wide-ranging, resulting in enhancements in academic performance, engagement, motivation, and a variety of other learning outcomes. Significant enhancements in academic performance have been observed across different subjects. In science, cognitive and achievement motivation increased [55], while non-digital gamification in math led to improve performance [60]. Physics saw gains through a gamified mobile app [74] and a gamified e-learning system increased both self-regulated learning and academic achievement in English language acquisition [53]. Reading and writing skills also showed slight improvements when compared to traditional methods [52], [77].

Engagement and motivation consistently emerged as positive outcomes of gamification. In science learning, tools like Kahoot! increased motivation [56] and physical education saw a rise in intrinsic motivation [64]. Quizizz was effective in improving motivation and reducing stress during evaluations [57]. Language learning benefited from game-based approaches like *Among Us* which enhanced motivation [52], while platforms like Kahoot! increased engagement, motivation, and autonomy across various subjects [70]. Additionally, there was improved satisfaction and motivation in renewable energy learning [58]. Beyond these core impacts, gamification also positively affected other aspects of learning. Game-based learning proved beneficial for computer science terminology acquisition and students showed better understanding and engagement with sustainable mobility concepts [61], [66], [67]. Physical education saw improvements in motor skills and reduced perceived effort [65] and deep gamification in computational thinking instruction had a stronger impact on motivation [62]. Digital gamified activities boosted both learning and interest in mathematics [59] and multimedia experiences enhanced specific English language skills [51]. Gamification has improved concentration in students with ADHD [69], increased enjoyment and cooperation in general subjects as well as the effective use of tools like Kahoot and Quizizz for providing feedback and improving learning [72], [73]. There were also significant increases in programming learning results [63], positive outcomes in technology education [75], mathematics [76], and the development of healthy habits [68] with a clear preference among students for gamified learning activities [71].

4. CONCLUSION

The implementation of gamification in primary education has yielded encouraging results in various subjects, showing positive effects on academic performance, motivation, engagement, and specific learning outcomes. Studies from diverse geographical areas have employed a wide range of gamification techniques, including digital platforms like Kahoot! and Quizizz, as well as non-digital methods and custom-designed gamified experiences. Although most findings are favorable, there are still knowledge gaps that need to be addressed. Further exploration is necessary to understand the long-term effects of gamification, its influence on different learning styles, and potential adverse effects. Additionally, more research is required to assess the effectiveness of specific game elements in various educational settings. Future studies should prioritize longitudinal designs, standardized measurement tools, and cross-cultural comparisons to enhance the applicability of the results. Furthermore, investigating the integration of emerging technologies such as artificial intelligence (AI), AR, and VR with gamification in primary education could provide valuable insights for future educational methodologies.

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This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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Muhammad Zuhair Zainal	✓	✓			✓	✓		✓	✓	✓		✓	✓	✓

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest regarding the publication of this work.

DATA AVAILABILITY

Data sharing is not applicable as this study did not generate or analyze original datasets. All information is present within the manuscript.

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