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GAMIFICATION ELEMENTS FOR SUSTAINABILITY LEARNING: A SCOPING REVIEW

Yugeshineey Subba Rao (a)*, Rita Wong Mee Mee (b), Khatipah Abd Ghani (c),
Lim Seong Pek (d), Wong Yee Von (e), Md Rosli Ismail (f),
Tengku Shahrom Tengku Shahdan (g)
*Corresponding author

(a) Universiti Selangor, Selangor, Malaysia, yugeshineey@gmail.com
(b) Universiti Selangor, Selangor, Malaysia, ritawong@unisel.edu.my
(c) Universiti Selangor, Selangor, Malaysia, khatisj@unisel.edu.my
(d) Universiti Selangor, Selangor, Malaysia, limsp@unisel.edu.my
(e) Universiti Selangor, Selangor, Malaysia, yeevonwong@unisel.edu.my
(f) Open University Malaysia, Selangor, Malaysia, mdrosli@oum.edu.my
(g) Albukhary International University, Kedah, Malaysia, shahrom.shahdan@aiu.edu.my

Abstract

Gamification elements constitute a game. It can be present in either digital or analogue forms or both, regardless of its setting. The most commonly used elements are points, leader boards, badges, levels, and feedback. These game attributes are also widely used in the education field due to their potential to positively affect learners, especially the younger generation who are more inclined towards gamified learning compared to pen-and-paper activities. Therefore, a scoping review is conducted based on the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines to determine the current acknowledgement on the influence of game elements in education among young learners. A total of 364 citations were identified through six databases for this scoping review. A sum of 16 articles was deemed eligible to be selected. The findings indicate that those game elements impact young learners, especially when it involves their learning motivation as it successfully keeps them engaged in the process of acquiring knowledge and constantly wanting for more.

Keywords: Educational games, elementary education, game attributes, gamified learning

1. Introduction

The process of acquiring knowledge is perceived to be simple and straightforward when the learners are intrigued and willing to take the initiative (Buchner & Zumbach, 2018). Unfortunately, the refusal of the current younger generation to participate in the process is an obstacle to the smooth execution of teaching and learning. They are anticipating a fun environment rather than a traditional setting, despite its relevance. This is due to their interest in games and their features that promote engagement. Therefore, they expect their learning process to keep them participating regardless of how long it lasts.

This matter cannot be disregarded as it is proven that most learners seem to be motivated and engaged in gamified lessons compared to conventional ones (Chapman & Rich, 2018). The elements found in games play a huge role in making this circumstance possible. These game elements, also known as game attributes, can trigger learners' curiosity and prolong their involvement in a particular task. Hence, this present study is conducted to determine how effective the elements are in encouraging young learners towards a promising outcome.

The rationale for researching younger learners from elementary or primary school education is in view of the fact that pupils from this age group are more eager to participate in an activity or lesson. This refers to their inclination towards games, as mentioned before. It is also because they are more active than the older learners, who tend to be passive in the classroom. This study also takes their perception of the usage of game elements in their learning process into consideration.

The present scoping review will be a composition of five sections. Following the introduction, Section 2 regards the methods used as guidance to this study, whereas, Section 3 consists of the results of this review. In Section 4, the discussion is presented regarding the overall findings of this research, along with a conclusion in Section 5.

2. Methods

A scoping review framework by Arksey and O'Malley was referred in order to complete this paper. As displayed in Figure 1 below, the framework consists of five stages: (1) identification of research questions; (2) identification of relevant studies; (3) study selection; (4) charting of data; and (5) collating, summarising and reporting of results.
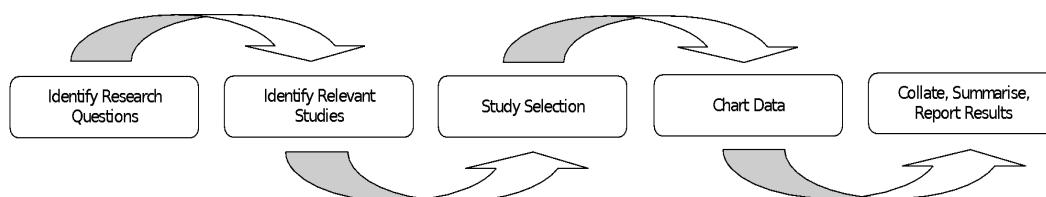
Figure 1. Methodological framework (Arksey & O'Malley, 2005)

2.1. Identifying the Research Questions

The review revolves around the involvement of game elements in an educational context that seems to have limited literature resources. Therefore, the research question addressed in this review – "what is empirically known from the existing literature about game elements in education" – was identified, based on the PCC (population/concept/context) model, as shown in Table 1 below.

Table 1. Research questions formed based on the PCC model

Research Question	Specific Objective
How is the research focused on game elements in education distributed?	To explore the temporal and geographical relationship and the setting in which studies on game elements in education have been developed
What is the research design used in the studies related to game elements in education?	To identify the research design used in studies on game elements in education
What is the purpose of conducting studies on game elements in education?	To identify the purpose of studies about game elements in education
What are the game elements used in education?	To identify the game elements used in education
What are the affected learning outcomes in the studies about game elements in education?	To determine the affected learning outcomes when game elements are integrated into education
How effective is the integration of game elements in education?	To summarize the effectiveness of game elements in education

2.2. Identifying Relevant Studies

The studies in relevance to the previously mentioned research were identified through search strings and keywords on multiple online databases such as Scopus, Web of Science (WOS), Education Resources Information Center (ERIC), Microsoft Academic, Semantic Scholar, and ScienceDirect. The Boolean operator OR and AND were used to assist in the refinement of the search strings. The search strings and keywords are displayed in Table 2 below.

Table 2. Search string/Keyword

Database	Search string/Keyword
Scopus	TITLE-ABS-KEY (("game element*" OR "game feature*" OR "game attribute*" OR "gamification" OR "game based learning") AND ("elementary education*" OR "primary school*") AND ("educational game*")) AND (LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017)) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (LANGUAGE , "English"))
Web of Science (WOS)	TS= (("game element*" OR "game feature*" OR "game attribute*" OR "game mechanic*") AND ("elementary education*" OR "primary school*" OR "young learner*" OR "language learning") AND ("educational game*" OR "gamification*" OR "game based learning"))
Education Resources Information Center (ERIC)	(gamification element OR gamified learning) AND (primary school OR young learner OR pupil OR elementary)

Microsoft Academic	gamification elements
Semantic Scholar	game element OR game attribute OR game feature AND elementary education OR primary school AND educational games
ScienceDirect	game element OR game feature OR game attribute AND elementary education OR primary school AND educational games AND gamification

2.3. Study selection

Game elements are widely used in different fields as it is not restricted to only the education domain. Hence, the research team opted to set inclusion and exclusion criteria to ease the search and eliminate the irrelevant studies. Two research team members removed duplicate records and screened the remaining papers by their titles and abstract to ensure they were eligible for the next step. Based on the predefined criteria as shown in Table 3, the qualified studies were then displayed in a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart.

Table 3. Inclusion and Exclusion Criterion

Inclusion criterion	Exclusion criterion
English language	Not in the English language
Journal article	Full text not attained
Focus on game elements	Irrelevant to the topic of game elements
Educational context	Not related to the education field
Focus on elementary or primary school learners	No involvement of elementary or primary school learners

2.4. Charting of data

The research team discussed and decided the attributes of the articles to be included in the chart – the title of the article along with its author and year of publication, country of origin, research design, aim or purpose of study, focused game elements, affected learning outcome and key findings. This crucial information was extracted from each of the finalised articles and charted by the first author.

### 2.5. Collating, Summarising, and Reporting the Results

The research team then reviewed the gathered data in the literature matrix to ensure it remains within the predetermined inclusion and exclusion criteria. It was reviewed again and updated by the senior author. Once finalised, the findings were presented in a report to ease the research team in producing the scoping review.

3. Results

A total of 364 citations were identified through six databases for this scoping review. Based on Figure 2, 11 articles were found from the Scopus database, whereas 22 were retrieved from Web of Science (WOS) and 94 from Education Resources Information Center (ERIC). Another 97 articles were identified in Microsoft Academic and 60 in Semantic Scholar, and 80 in ScienceDirect. Ten duplicate

articles were omitted, leaving a balance of 354 articles to be screened by title and abstract. However, 305 articles were excluded due to their irrelevance to the aim of this scoping review.

A total of 49 potentially relevant articles underwent an eligibility check via data extraction from the reviewed full texts. 37 articles were excluded due to multiple reasons: (a) 14 articles did not mention the presence of game elements; (b) 14 studies were focusing on a different target age group; (c) five articles did not conduct any research but merely reported information; and lastly, (d) four unattainable or inaccessible full texts. The remaining 12 studies were accepted to be included and discussed in this scoping review, along with an addition of four articles identified by hand search. Therefore, a total of 16 articles were analysed and presented in a literature matrix as displayed in Table 4.
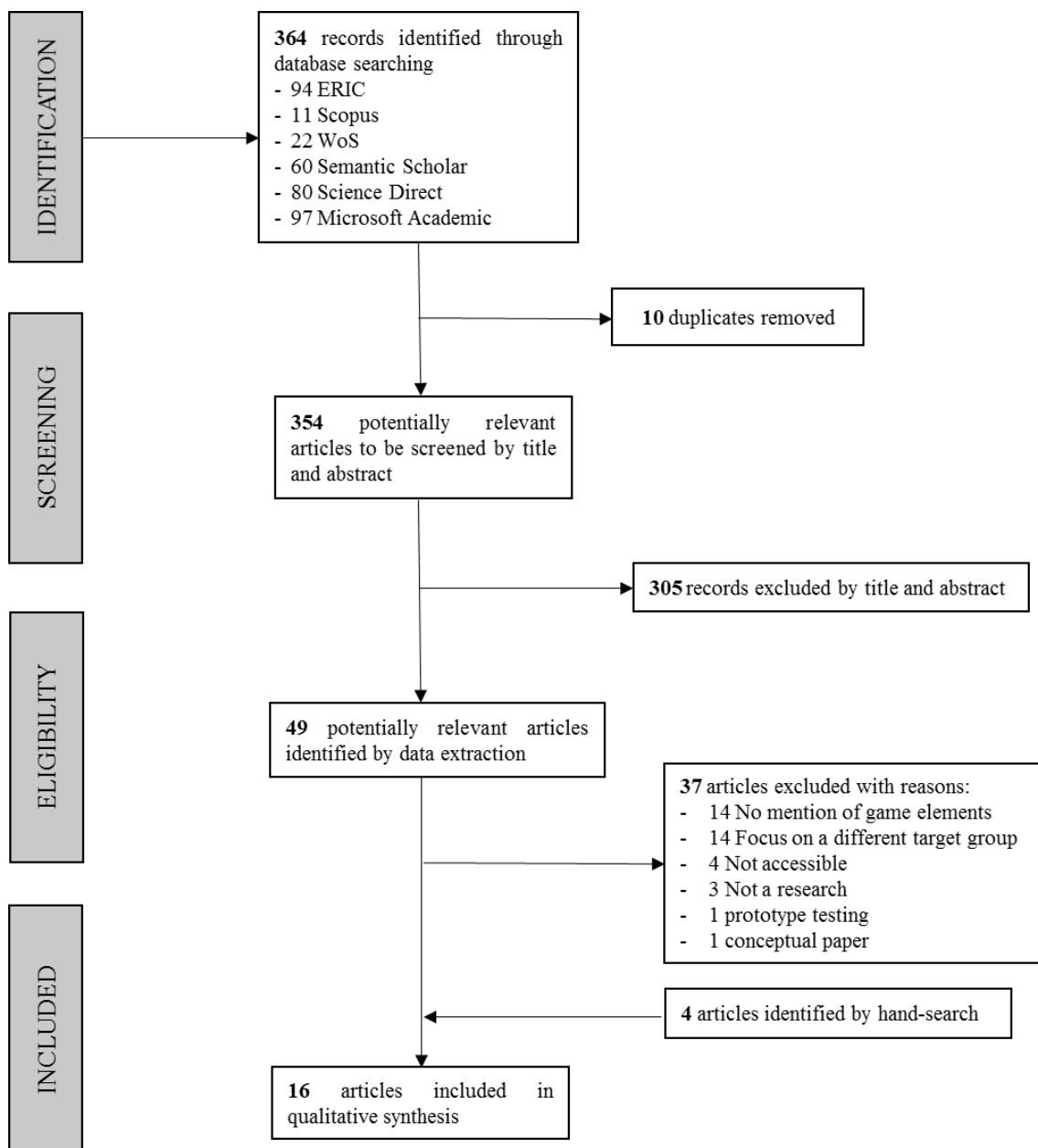
Figure 2. Flow diagram of scoping review

Table 4. Literature matrix of accepted articles

Title	Country	Research Design	Aim/Objective	Game Element	Affected Learning Outcome	Findings
How do games affect the writing skills of young EFL learners? (Åževik, 2020)	Turkey	Qualitative	To determine the effect of games on the writing skills of primary school 3rd grade EFL learners	Points	Writing skill	Primary school EFL learners' writing skills were influenced positively by the usage of games
A Pilot Intervention Using Gamification to Enhance Student Participation in Classroom Activity Breaks (Beemer et al., 2019)	United States	Qualitative	To investigate the effect of incorporating game elements to increase in-class physical activity participation	Badges, stickers, progress graph, feedback	Classroom participation	Gamification increased students' participation, especially in the 4th and 6th grade classrooms and female students
Formative assessment with interactive whiteboards: A one-year longitudinal study of primary students' mathematical performance (Chen et al., 2020)	China	Qualitative	To analyse the changes in the mathematical performance through formative assessment for primary school students participating in interactive whiteboard-based instruction.	Leader board, immediate feedback, points, avatars	Learning performance	The element of feedback in this study was able to clear students' doubts regarding the learning content.
Applying Digital Escape Rooms Infused with Science Teaching in Elementary School: Learning Performance, Learning Motivation, and Problem-Solving Ability (Huang et al., 2020)	Taiwan	Qualitative	To study the effectiveness of digital escape room (DER) on students' learning performance, learning motivation, and problem-solving ability.	Level, reward (coins)	Learning performance, learning motivation, and problem-solving ability	The digital escape room was effective in enhancing students' learning motivation and problem-solving ability but both comparison and experimental groups had the same level of performance.
Investigating the impact of an adventure-based 3D solar system game on primary school learning process (El Mawas et al., 2020)	Ireland	Qualitative	To identify the issues related to students' motivation and engagement and to enhance their learning experience in STEM subjects	Level, immediate feedback	Motivation, engagement, learning experience	The experimental group displayed better learning performance compared to the control group and the students had a great learning experience

We Play We Learn: Exploring the Value of Digital Educational Games in Rural Egypt (Lazem & Jad, 2017)	Egypt	Qualitative	To determine if digital technology can motivate primary students to collaboratively learn a difficult topic in Mathematics.	Level, points, feedback, challenge, progress bar	Motivation	Educationally disadvantaged students were affected positively using the game format as they were able to devise their own play and study strategies
Engaging children with educational content via Gamification (Nand et al., 2019)	New Zealand	Qualitative	To study the effect of gamification in an educational context and identify appealing game elements from the students.	Levels, feedback, challenges	Learning performance, motivation	The game elements were able to improve the students' learning outcomes and boost their motivation
Investigating the effects of gamifying homework on students' perceived satisfaction, behavioral intention and intrinsic motivation (Metwally et al., 2019)	Not stated	Qualitative	To investigate the students' level of satisfaction, attitude, and behavioural attention as well as their motivation when involved in a gamified learning setting.	Experience points (XP), leader boards, badges, levels, progress bars, awards, challenges, timer	Enjoyment, motivation	Gamification elements enhance students' satisfaction levels, behavioural intentions, and intrinsic motivation.
Design Rationales of a Mobile Game-Based Intervention for German Dyslexic Children (Holz et al., 2018)	Germany	Qualitative	To present the design of a mobile serious game that involves gaming elements, for dyslexic children	Feedback, points	Engagement	The children displayed a positive perception of the game elements
Evaluating the use of gamification in mathematics learning in primary school children (Cunha et al., 2018)	Not stated	Qualitative	To evaluate the use of gamification in Mathematics learning in primary school students	Levels, badges	Motivation, achievement	Students improved their learning experience in a positive and effective way via gamification to gain new information
Examining competitive, collaborative and adaptive gamification in young learners' math learning (Jagust et al., 2018)	Not stated	Qualitative	To determine the effectiveness of different gamification types in learning processes and performance	Points, leader board, timer, feedback	Learning performance	Gamified activities improved learners' learning performance in Mathematics
Applying game mechanics and student-generated questions to an online puzzle-based game learning	Not stated	Qualitative	To study the effects of using game elements to promote algorithmic thinking skills in an online puzzle-	Points, feedback, challenges, leader board, levels, badges,	Thinking skill, learning	Game elements improve students' algorithmic thinking skills and

system to promote algorithmic thinking skills (Hsu & Wang, 2018)			based game learning system.	progress bar	performance	performance in solving puzzles
The effect of pedagogical GAME model on students' PISA scientific competencies (Tsai et al., 2020)	Taiwan	Qualitative	The effect of a pedagogical model of digital games on students' scientific competencies.	Points, rewards, levels, and badges	Scientific competency	The gamification, assessment, modeling and enquiry (GAME) model can enhance students' Programme for International Student Assessment (PISA) scientific competencies.
Learning about sustainable mobility in primary schools from a playful perspective: A focus group approach (Sipone et al., 2019)	Spain	Qualitative	To determine the influence of gamification in learning related to sustainable mobility.	Avatar, points, rewards, and challenges	Participation, motivation	Children were aware of sustainable mobility and were able to gain new knowledge regarding the concept via gamification elements
Gamification and physical education. Viability and preliminary views from students and teachers. (Fernandez-Rio et al., 2020)	Spain	Qualitative	To study the application of gamification in Physical Education and its effect on students and teachers.	Rewards, badges, immediate feedback	Motivation	Gamification has the potential to improve students' intrinsic motivation toward physical education
Evaluation of Gamification in E-Learning Systems for Elementary School Students (Alshammari, 2020).	Saudi Arabia	Qualitative	To study the effect of gamification in e-learning systems on students' learning outcomes and learning motivation in an Arabic language course	Points, time pressure, levels, badges, rewards, feedback, leader board.	Motivation	The usage of game elements boosts students' motivation to acquire knowledge

    i.   Research Question 1: How is the research focused on game elements in education distributed?

A total of n=16 studies related to the integration of game elements in education were taken into consideration to be included in this scoping review. It was retrieved from six different databases – Scopus, Web of Science (WOS), Education Resources Information Center (ERIC), Microsoft Academic, Semantic Scholar, and ScienceDirect. In terms of distribution, Taiwan (Huang et al., 2020; Tsai et al., 2020) and Spain (Fernandez-Rio et al., 2020; Sipone et al., 2019) conducted n=2 studies on the usage of game elements in an educational setting. There were n=8 studies from Turkey (Åževik, 2020), the United States (Beemer et al., 2019), China (Chen et al., 2020), Ireland (El Mawas et al., 2020), Egypt (Lazem & Jad, 2017), New Zealand (Nand et al., 2019), Germany (Holz et al., 2018), and Saudi Arabia (Alshammari, 2020), where the countries contributed one study each. However, n=4 (Cunha et al., 2018; Hsu & Wang, 2018; Jagust et al., 2018; Metwally et al., 2019) studies obtained from the databases had no country of origin stated.

    ii.   Research Question 2: What is the research design used in the studies related to game elements in education?

From the accumulated 16 articles, which revolve around the inclusion of game elements in the educational context, all the studies (Alshammari, 2020; Åževik, 2020; Beemer et al., 2019; Chen et al., 2020; Cunha et al., 2018; El Mawas et al., 2020; Fernandez-Rio et al., 2020; Huang et al., 2020; Hsu & Wang, 2018; Holz et al., 2018; Jagust et al., 2018; Lazem & Jad, 2017; Metwally et al., 2019; Nand et al., 2019; Sipone et al., 2019; Tsai et al., 2020) applied the qualitative method. Experiments were conducted via pre-tests and post-tests using control and treatment groups. Observations were done, and the outcomes were evaluated via questionnaires or oral interviews to obtain the participants' feedback.

    iii.   Research Question 3: What is the purpose of conducting studies on game elements in education?

There are numerous motives to why studies were conducted on the presence of game elements in education. The majority of the studies focused on game elements' effect on learners' learning performance and motivation, with n=6 articles (Alshammari, 2020; Fernandez-Rio et al., 2020; Huang et al., 2020; Jagust et al., 2018; Lazem & Jad, 2017; Metwally et al., 2019). A total of n=3 articles (Cunha et al., 2018; Chen et al., 2020; Jagust et al., 2018) emphasized how the incorporation of game elements influenced learners' learning process. On the other hand, n=2 article (Beemer et al., 2019; Nand et al., 2019) highlighted the learners' participation and n=1 (El Mawas et al., 2020) on their engagement and learning experience. This review also individually identified n=1 articles on improving learners' thinking skills (Hsu & Wang, 2018), science competency (Tsai et al., 2020), problem-solving ability (Huang et al., 2020), and writing skills (Åževik, 2020). Lastly, there was one article regarding the design of a mobile serious game for dyslexic children (Holz et al., 2018) and another on sustainable mobility (Sipone et al., 2019).

iv.   Research Question 4: What are the game elements used in education?

Many game elements were mentioned in the sixteen articles, but there were also combinations of them used in some studies. Points (Alshammari, 2020; Åževik, 2020; Chen et al., 2020; Holz et al., 2018; Hsu & Wang, 2018; Jagust et al., 2018; Lazem & Jad, 2017; Metwally et al., 2019; Sipone et al., 2019; Tsai et al., 2020) and feedback (Alshammari, 2020; Beemer et al., 2019; Chen et al., 2020; El Mawas et al., 2020; Fernandez-Rio et al., 2020; Hsu & Wang, 2018; Holz et al., 2018; Jagust et al., 2018; Lazem & Jad, 2017; Nand et al., 2019) were the most popular as they appeared in n=10 articles each. Levels were present in n=9 studies (Alshammari, 2020; Cunha et al., 2018; El Mawas et al., 2020; Huang et al., 2020; Hsu & Wang, 2018; Lazem & Jad, 2017; Metwally et al., 2019; Nand et al., 2019; Tsai et al., 2020). Badges (Alshammari, 2020; Beemer et al., 2019; Cunha et al., 2018; Hsu & Wang, 2018; Metwally et al., 2019; Tsai et al., 2020) and rewards (Alshammari, 2020; Beemer et al., 2019; Fernandez-Rio et al., 2020; Huang et al., 2020; Metwally et al., 2019; Sipone et al., 2019;Tsai et al., 2020) were stated in n=7 articles, whereas leader boards (Alshammari, 2020; Chen et al., 2020; Hsu & Wang, 2018; Jagust et al., 2018; Metwally et al., 2019) and challenges (Hsu & Wang, 2018; Lazem & Jad, 2017; Metwally et al., 2019; Nand et al., 2019; Sipone et al., 2019) were mentioned in n=5 articles, respectively. Lastly, progress bars or graphs appeared in n=4 studies (Beemer et al., 2019; Hsu & Wang, 2018; Lazem & Jad, 2017; Metwally et al., 2019), while timers were found in n=3 studies (Alshammari, 2020; Jagust et al., 2018; Metwally et al., 2019) and avatars in n=2 (Chen et al., 2020; Sipone et al., 2019).

v.   Research Question 5: What are the affected learning outcomes in the studies about game elements in education?

The majority of the studies included in this scoping review, n=9 (Alshammari, 2020; Cunha et al., 2018; El Mawas et al., 2020; Fernandez-Rio et al., 2020; Huang et al., 2020; Lazem & Jad, 2017; Metwally et al., 2019; Nand et al., 2019; Sipone et al., 2019), emphasized the usage of game elements to boost learners' motivation to acquire knowledge. Learning performance was also frequently highlighted in n=5 studies (Chen et al., 2020; Huang et al., 2020; Hsu & Wang, 2018; Jagust et al., 2018; Nand et al., 2019), along with engagement in n=2 (El Mawas et al., 2020; Holz et al., 2018). The subsequent learning outcomes discovered from the articles were classroom participation (Beemer et al., 2019), writing skills (Åževik, 2020), scientific competencies (Tsai et al., 2020), thinking skills (Hsu & Wang, 2018), problem-solving ability (Huang et al., 2020), learning experience (El Mawas et al., 2020), enjoyment (Metwally et al., 2019), achievement (Cunha et al., 2018), and participation (Sipone et al., 2019).

vi.   Research Question 6: How effective is the integration of game elements in education?

Based on this scoping review, all the studies considered reported positive findings pertaining to the effectiveness of game elements in education. Most of the results, n=6 (Alshammari, 2020; Fernandez-Rio et al., 2020; Huang et al., 2020; Lazem & Jad, 2017; Metwally et al., 2019; Nand et al., 2019), revolved around the improvement of learners' motivation. The participants also displayed better learning performance when game elements were present in their lessons in n=3 articles (El Mawas et al., 2020; Hsu & Wang, 2018; Jagust et al., 2018). A study stated that gamification aids in clearing their doubts (Chen et al., 2020), while another mentions the learners' positive perception of game elements (Holz et

al., 2018). n=2 studies (Cunha et al., 2018; Sipone et al., 2019) mentioned that gamification was deemed an effective way to gain new information and there was also an improvement in the learning experience in n=2 (Cunha et al., 2018; El Mawas et al., 2020). Besides, the learners claimed in an article that their writing skills (Åževik, 2020), participation (Beemer et al., 2019), problem-solving abilities (Huang et al., 2020), satisfaction levels (Metwally et al., 2019), thinking skills (Hsu & Wang, 2018), and scientific competencies (Tsai et al., 2020) are influenced positively when game elements are used.

4. Discussion

4.1. Gamified Learning

Younger learners perceive learning as a tiresome process because they cannot have fun due to the approach and strategies opted by their teachers. They are more exposed to technology and gadgets and everything it has to offer – games. Educators can take advantage of this situation and apply a similar context in their teaching. The addition of game elements transforms the lesson to attract the pupils' attention, as stated by Karmila Rafiqah et al. (2019). This urged researchers to conduct studies to venture deeper into integrating game elements in an educational context (Kyewski & Kramer, 2018).

Rafiq's study also highlighted the pupils' view toward gamified learning. They claimed to be more intrigued and motivated in such lessons as they could be autonomous learners. Their thinking skill improvements were also mentioned, along with their positive learning experiences. These claims indeed call for a change in the educational settings to ensure teachers can aid their pupils in achieving their academic goals. On the other hand, Hashim et al. (2019) contribute to the previous statement by mentioning the opportunity for learners to compete healthily against their peers with game elements in a gamified lesson.

4.2. Game Elements

Gamified learning is impossible to execute without the presence of game elements. The game elements, or game attributes, serve as a tool to facilitate the pupils towards their motive by ensuring their interaction with the learning process, as mentioned by Stanculescu et al. (2016 as cited in Siti Nurul Mahfuzah Mohamad et al., 2017). They are the key to boosting learners' determination to acquire knowledge and communicate with their friends in a collaborative learning environment, according to Ding (2019).

Although educators practice alternate methods to keep their learners glued to instructional content, it may seem forced. This sadly results in their refusal to be a part of the lesson. Thus, the practical way would be to divert and attract them towards something worth their attention, which refers to the game elements of their interest. On the other hand, it promotes student-centered learning, which helps them acquire knowledge at their own pace, stimulating good learning behaviours.

5.   Conclusion

As revealed throughout the report, game elements remain a subject matter researched and applied in various domains. This study acknowledges the limited resources related to the inclusion of game elements in the curriculum and how it positively influences young learners' knowledge acquisition and their learning process. This review also urges more studies to be conducted to show the potential possessed by game elements on how it improves learners' academic achievement and enhances their existing 21st-century skills, which is a prerequisite to cater to the current era.

Acknowledgments

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