

A Systematic Literature Review of Gamification for Children: Game Elements, Purposes, and Technologies

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Abstract— Technology continues to develop tools and applications to help students learning, especially in early childhood education. This innovation has an impact on children's learning behavior and activities since children are familiar with and enjoy playing with digital games. Previous research has attempted to combine the fun aspects of games with the learning aspects of games to create child-friendly activities. Gamification helps to create an effective educational environment in order to increase children's motivation, engagement, and learning performance. However, there are few studies that discuss the impact of gamification on children's learning, as well as the types of game elements and technology that are acceptable for them. This study presents a systematic literature review on gamification in order to identify the types of goals, game elements, and trends in gamification technology for the younger generation. In this study, 20 research articles were selected to be reviewed from four database sources (IEEE Xplore, ScienceDirect, Scopus and ACM) from 2017 to 2021. The results showed that the primary goal of gamification for children were to increase motivation and engagement. Several elements, such as points, levels, and leaderboards, were frequently used in the game. Finally, mobile applications were commonly used for gamification in the learning process of children.

Keywords—children, gamification, element game, literature review, technology

I. INTRODUCTION

Technology continues to evolve, driving the development of innovation in many areas of people life. Number of activities are assisted by technology either in the form of tools or applications such as banking, agriculture, mining, education, trade, and others [1]. Adults utilize technology for work, while children use it for play. Play activities are loved by children and very important in building their character. By playing the children will interact with the environment and their friends. The development of information technology makes a difference to children's play activities. The technology they use to play games.

New learning trends are emerging due to the large number of children who tend to play games. This trend makes children interested in learning because it combines elements of fun and

learning [2]. There are several ways to combine learning with game elements. First, a game-based learning approach with the goal of achieving the goal of learning by using fun games [2]. This combination makes learning more enjoyable. Second, using serious games which is not only makes the game fun but also to convey a message, lesson or experience [3]. Third, using gamification that utilizes game elements in a non-gaming context [4].

Gamification has become increasingly popular and successfully applied in various educational contexts [1]. Previous studies found that gamification was effectively improved students' motivation and learning outcomes [5]–[7]. Study of [6] uses gamification mechanisms in web-based collaborative reading annotation system (WCRAS) to increase student annotation behavior and improve reading comprehension [6]. Another study [7] found that gamification encourages student behavior, emotional, and cognitive involvement in online discussions. According to [8], student's motivation and teamwork were both affected by the experience with game.

Gamification in education can increase learning motivation, engagement, collaboration and effectiveness of students in learning by adding game design principles in the learning environment [1]. Games can be used to complement the information developed by the school, using frameworks and game mechanics so that it becomes a new learning style [9].

The aim of the research is to identify game elements and gamification technology for kids. Each gamification has its own goals that want to be achieved such as increased motivation, involvement in learning. The goal will be reached by applying suitable game elements and technologies.

To achieve the objectives of the study, the basis of the theory and the right tools are required. In this research, there are three questions. First, "what game elements are used that impact the child's learning?". Secondly "what is the purpose of gamification in children's learning?". Thirdly "what is the gamification technology used in children's learning?". The study was conducted over literature studies related to gamification for children which conducted from 2017-2021.

II. RESEARCH METHODOLOGY

Systematic literature review (SLR) is a secondary study of a research topic or problem. The SLR is has four main activities: clarifying research questions; identify and explain related research; systematically assess research reports and combine the results into related statements, and determine the evidence in accordance with those obtained from research [10]. The purposes of SLR is to recognize, classify, synthesis analysis of the state of study and advance learning [11].

There are several steps in literature review process. First, determine the search keywords and source of the research article in this study. In this study, four research article sources are selected, namely Science Direct, IEEE Explorer, Scopus, and ACM Digital Library. The search process is assisted by "AND" and "OR" operators so that the search results are relevant to the research question. To limit the search, the "AND" operator is used to studies consisting of words registered in the particular quest index, the order is ignored, while to retrieve studies in which at least one term is in the specified quest index, the "OR" operator is used.

Second is to select research articles based on titles and abstracts that linked to gamification for children or gamification for education. Third is to arrange selected articles build upon research background, then to better understand, read the content and discussion described in detail. These results will be the basis for learning more and for proposing or evolving gamification for kids. Finally, the research questions about the purpose, element gamification, and gamification technology for children will be able answered by systematic literature review.

A. Research Questions

A research question is needed in order to focus on the purpose of this study. Table I shows the list of research questions of this research.

TABLE I. LIST OF RESEARCH QUESTION

Research Question	Motivation
RQ1-What are gamification elements that have an impact on children's education?	Recognize parts of gamification that have an impact on children's education.
RQ2-What is the purpose of gamification on children education?	To find out the purpose of gamification for kid's education.
RQ3-What kind of gamification technologies that is popular in children's education?	To find out type of technologies commonly used in children's education.

B. Searching Process

The search for research articles was taken out on predetermined database sources. The search usages predefined keywords. The following is the database source used.

- Scopus (<https://www.scopus.com>)
- IEEE Xplore (<https://ieeexplore.ieee.org>)
- Science Direct (<https://www.sciencedirect.com>)
- ACM Digital Library (<https://dl.acm.org>)

Keywords used in search must match with research question. Research articles can be obtained by entering a combination of keywords and boolean operators. Children AND (gamification or gamify education) is the primary logic of the search. Several keyword combinations are used to maximize the result of the primary logic. Some of the primary logical combinations are as follows:

- Children AND (gamification OR gamify education)
- (Children AND gamification) OR (children AND gamify education)
- (Children AND gamification) OR (children and educational gamification)

This search process is carried out into three steps. First, search one by one in the database sources mentioned by using the predetermined keyword combinations. Second, test the relevance of the paper to the research question by reading the title and abstract of the research paper. Prospective studies are the result of this process. Third, selected study candidates which answer the research question are read thoroughly. The results of the research are selected research that will be reviewed.

C. Result Finding

The method used in answering research questions is a search on a predetermined source database. Studies taken from database sources amounted to 1,508 papers. Table II shows the search results from the source database.

TABLE II. SEARCH RESULT FROM SOURCE DATABASE

NO	Source Database	Result
1	Science Direct	106
2	ACM Digital Library	509
3	Scopus	662
4	IEEE Xplore	231
Total		1508

In this study, filtering the research article using inclusion and exclusion criteria. Eligibility or ineligibility of a study to be included in this study is determined by these criteria which are the limitations of this study. Everything that must be owned by the research is called the inclusion criteria and the factors that make a study do not meet the requirements of this study are called the exclusion criteria. These criteria can be seen in table III.

TABLE III. INCLUSION AND EXCLUSION CRITERIA

Criteria		
Inclusion	I1	Papers written in English
	I2	Papers appertain to gamification elements and technology for children
	I3	Full text articles
	I4	Papers in the form of journals or proceedings
Exclusion	E1	Book chapters, book papers, and thesis
	E2	gamification elements and technology for children are not described in the abstract in the paper
	E3	Non-gamification related papers for children
	E4	Similar articles from different database

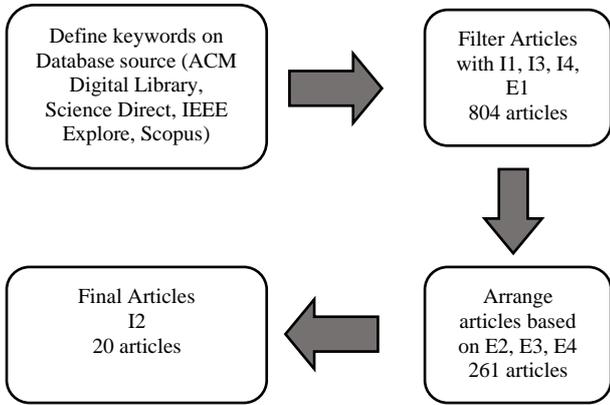


Fig. 1 Research article screening process

The research article screening process and the results of each screening process are shown in Figure 1. After filtering 1508 articles in accordance with the criteria of inclusion and exclusion in table III, 20 articles will be reviewed. The article will be read, analyzed, and mapped according to the research question. The distribution of the article can be seen in table IV.

TABLE IV AMOUNT OF ARTICLE AFTER SELECTION PROCESS

NO	Publication Media	Number of Articles
1	Q1 Journal	7
2	Q2 Journal	3
3	Q3 Journal	1
4	Conference Proceeding	9
	Total	20

D. Related Work

There are several studies about gamification for children. The first is the study of language, learning English using a mobile application for kindergarten, gamification keeps children motivated to learn English [12], another study uses points and rewards as game elements to motivate children to learn regional languages using mobile applications [13]. Second study about health, prevent obesity in children using mobile applications, game elements are used to provide intervention in obesity prevention activities in children [14][15], another study, family nutrition literacy for children aged 3-5 years using a web-based application, this gamification platform is quite interactive and easy for learning healthy eating [16]. During this pandemic, a gamification application was developed, namely the snake and ladder game to socialize health protocols to children. The government can use the application as a strategy for socializing health protocols for early childhood [17].

In 2017 [1] conducted a study which stated the need for a systematic program of experimental studies that mapped game elements for each group of students so that it was relevant to the learning objectives of the group, and the specific motivations of individual (group) students. Another gray area that needs to be addressed is how to avoid gamification events that are detrimental to learning. In 2020, [2] published a study that focused on the research methodology, the underlying theoretical model, the

gamification platform, the search for the most regularly used trends, participant preferences, and the most widely used game features in education. Student involvement and motivation, academic accomplishment, and social connectivity were recognized as learning outcomes and impact categories.

III. RESULT STUDY

A. Element of Gamification on Children Learning

Element games are the basis of gamification that describes the interaction of players to achieve the objectives of the game. Game element reviews on 20 papers based on game elements according to [18] i.e. point, levels, leaderboards, badges, progress, stories, feedback and rewards [18] which shown in Table VI. Element of gamification affect children learning. The results showed that point, levels, and leaderboards are the most widely used in children's learning.

Points in the game can be used as indicators to gain user performance, the more points the better the user's performance [19]. Levels show the progresses or achievements of users in completing the game [19]. Leaderboards mostly used to keep users motivated for completing the learning in a fun way [19]. Points, levels and leaderboards are also known as rewards [20]. The child's motivation to continue learning will also be triggered by the provision of rewards. Getting the highest rewards and highest points will make children feel smarter and try to continue to improve their learning skills[12].

In research [11] points, leaderboard, rewards, badges and levels are referred to as game mechanisms. The relationship between the game mechanism is used to change behavior in children with diabetes mellitus. Other studies have found that using points, levels, and rewards to achieve healthy challenges can improve the effectiveness of school-based obesity prevention interventions in primary school students. [14]. Finally, the application of gamification can improve performance, effectiveness and efficiency in changing children's eating patterns which have an impact on healthy eating habits for children with diabetes mellitus.

TABLE V. ELEMENT OF GAMIFICATION AFFECT CHILDREN'S LEARNING

NO	Element	Articles
1	Point	[15][12] [19][21][13][22][23][24][20][25][26][27][14][28][14]
2	Levels	[6][15] [12][29][19][21][22][23][24][20][26][14]
3	Leaderboards	[6] [29][19][30][22][20][26][27][14][31]
4	Badges	[16][19][30][22] [28][31]
5	Progress Bar	[16] [29][32][21]
6	Stories/themes	[32][26][28]
7	Feedback	[6][32][21][24][27][28]
8	Rewards	[32][29][13][25][27][28][31]

B. Purpose of Gamification on Children Learning

Previous studies found that gamification in children learning were mainly to increase motivation, engagement,

enjoyment, and performance of children in the learning process. Learning using gamification makes children feel happy and comfortable (enjoyment) thus increasing their confidence and motivation in the learning [12], gamification can also boost student motivation and engagement [28]. In addition, gamification also increases children's interest in lessons.

Gamification can increase child's activity and engagement so that the learning process [22] increases participation [12], and the child's performance in the learning process [6], [19]. The results showed that gamification is widely used to increase motivation and engagement in children, as seen in Table V. Moreover, motivation and engagement are used as main purpose because children feel enjoy by the lessons which affect their learning performances.

TABLE VI. PURPOSE OF GAMIFICATION ON CHILDREN LEARNING

NO	Purpose	Articles
1	Motivation	[6] [15][16][12][29] [13][22] [24][20][25][27][14][28][14][31]
2	Enjoyment	[12] [21]
3	Engagement	[6] [15][29][22] [21] [32] [30][23][28][31]
4	Performance	[6] [19]

C. Gamification Technology for Children

Various technologies are used in the implementation of gamification for children. The platform used will affect the efficiency of gamification used in the learning system. So that the environment for system implementation must be in accordance with the personality and emotions of the child [22]. The implementation of web-based usage is used for an alternative face-to-face approach, with the addition of web gamification to become more interactive so that it is useful as an educational tool and easily adapted for the learning process [16]. Mobile apps gamification is an innovative approach to children in the learning [13]. Gamification applications in mobile devices can have a major impact on the learning [21], it can also be used as a strategy to maintain social distance and facilitate learning during a pandemic. Augmented reality coupled with gamification will offer "enormous educational potential" [23]. Table VII shows type of technologies used in gamification for children. Web apps and mobile apps are the most widely used technologies.

TABLE VII GAMIFICATION TECHNOLOGY FOR CHILDREN

Technology	Articles
Web Apps	[6][15][16][30][22] [14]
Mobile apps	[12][29][13][21][19] [24][20][26][28][14][31]
Android Apps	[32][27]
Virtual Reality	[29]
Augmented Reality	[29][23]
Desktop application	[25][28]

Gamification in learning and digital mobile devices are now commonly considered as strong teaching tools for youngsters. [33]. Based on review mobile applications are the most widely used technology in the implementation of gamification for children, 55% research articles or 11 articles out of 20 articles using mobile apps technology. The

implementation of gamification with mobile apps is liked by children because it is more attractive and the existence of innovations in games is increasingly attractive to children, thereby increasing children's motivation in learning [16], [24], For some children, interacting with mobile applications is a fun process while learning various things [24].

IV. CONCLUSION

Gamification is used by children of all ages to aid in the learning process. Gamification was frequently used to assist learning and socializing about health protocols in youngsters during the pandemic. The goal of this study is to understand more about gamification in children's learning, including game elements, purposes, and technology. Based on the review, it is concluded that the purpose of gamification in children's learning is to increase motivation, enjoyment, involvement, and performance. The most widely used in game elements are point, levels, and leaderboards. For the technology, mobile apps are mainly used based on the previous studies.

Furthermore, several ideas are pleasant to be discuss in future study. First, information and analysis which elements are most suitable for children's psychological development and technological developments such as virtual reality. Second, it is necessary to conduct research on 3D virtual technology implemented on mobile devices in order to make it easier to use, more interactive and provide interesting visualizations. Finally, investigate the psychological impact of gamification components on children's personalities in order to improve motivation, engagement, enjoyment and learning performance.

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