Bibliometric Analysis of The Term Game-Based Learning in Early Childhood Studies

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Abstrak: Game-based learning is a learning model that motivates and is believed to improve various aspects of student development. GBL has become a study that has begun to be of great interest to researchers. However, game-based learning applied to early childhood education has not been widely practised. This study aims to provide an extensive bibliometric review of game-based learning in early childhood. Articles were searched using the scopus.com database, and 428 articles were captured. After screening with inclusion and exclusion criteria, 256 articles were deemed eligible. The results of the study indicate that through the resulting bibliometric map, it can be seen that the opportunity to study game-based learning in early childhood studies is very prospective, especially those related to human-computer interaction.

Keywords: Game-Based Learning; Early Childhood; Bibliometric Analysis; Gamification; Kindergarten.

INTRODUCTION

Educational institutions need to always reconstruct educational services from time to time. It is necessary because life's dynamics involve not only one or two aspects, but almost all aspects of life need attention. The learning approach always leads to learning objectives, but the most important thing is how to achieve these objectives. Along with the rapid trend of society towards technology, schools should consider including technology in the planning and implementation of teaching. Therefore, educational institutions are expected to focus on aspects or efforts that will support the achievement of educational goals, including technology in learning.

Educational institutions are constantly trying to find the right strategy to support their efforts to achieve educational goals. One strategy that can be used in achieving educational goals is to integrate gamification into learning. The most popular term for gamification in education is game-based learning (also known as GBL). The use of GBL has increased significantly along with the development of information technology. GBL emerged in 1985 when game-based learning was used in army training and education (Simutis & Barsam, 1983).

Then, at the turn of the century, the term digital game-based learning (DGBL) was popularized through the writings of Marc Prensky (2001) and James P. Gee (2003). Gee even outlines 36 learning principles that successful commercial video games may use to transform education and affect how people learn (Loh et al., 2015). The ability of this educational computer game to establish a centralized learning environment where students develop skills and increase their knowledge while playing games is well acknowledged.

GBL has become a study that has begun to be of great interest to researchers. Several researchers include (Behnamnia et al., 2020; Flynn et al., 2021; Hawthorn et al., 2021; Juhani Lyytinen et al., 2021; Rodríguez et al., 2021; Schwarz et al., 2020) have conducted a study on GBL with a systematic literature review approach. (Flynn et al., 2021) conducted a comprehensive systematic literature review on GBL based on 73 articles from 47 peer-reviewed journals. This review reveals a research design that has been used to examine learning content and cognitive skills among children aged 6 to 12 years in the context of a digital game. The literature review led these researchers to conclude that most of the articles reviewed in the context of digital games wrote about game development with didactic purposes. A small part is being developed for commercial purposes. Of course, this impacts the quality of the resulting game creations. It is due to the size of the budget in the study.

Other authors review various surveys and studies to see if technology DGBL applications (tablets and smartphones), can improve creativity skills in preschool children (ages 3-6). All data was obtained from secondary data. This survey was developed using a literature review of article documents over the last decade and found 67 articles, of which only 20 were considered eligible. The results showed that the use of DGBL had an active effect on strengthening children's creative thinking. This study provides new insights and effective advice for researchers, designers and game developers on improving creative skills, motivating, and improving learning outcomes in preschool students.

Bibliometric analysis on the topic of GBL was conducted by (Martí-Parreño et al., 2016) 139 articles were published in leading journals over the last 5 years (2010-2014). The aim is to identify relevant authors and institutions, the main constructs and themes involved, and

trends in knowledge development. The main findings show the increasing interest of researchers in this study over the last 5 years. From the results of the bibliometric analysis, various topics or main themes are identified, which are grouped into four main themes: effectiveness, acceptance, engagement and social interaction.

Based on the search results that we have done, no bibliometric analysis with the theme of GBL in early childhood has been found. This study is to fill in the gaps by providing an extensive bibliometric analysis of the literature related to this theme to answer the following questions: a) How are GBL articles classified for early childhood? b) What are the research trends of GBL in early childhood? Which research topics are the most published? c) What future topics of GBL in early childhood provide opportunities for further research?

MATERIAL & METHODS

Data Source

This study aims to identify and present the state of intellectual structure and emerging trends regarding game-based learning in early childhood. The keywords game-based learning, digital game based learning, gamification, serious games, educational games and preschool, kindergarten, early childhood are used to facilitate the search. The data source was obtained through a literature search through the Scopus journal indexing page (Scopus.com). The literature search was carried out in July 2022. The search results obtained 428 articles published from 1985 – July 2022. The number of data sets obtained was adequate and feasible to be analysed using bibliometric analysis (Donthu et al., 2021).

In this paper, several non-conforming articles were excluded; table 1 shows the inclusion and exclusion criteria screening results. Inclusion criteria include 1) the paper is an article published by a reputable journal and international conference, and 2) the paper is an article about the world of education. The author excludes papers outside of early childhood education.

Table 1. Number of Articles Searched with Screening Criteria

Search Screening	Number of Articles
articles and conference papers relevant	256
articles in press	10
conference review/review/book chapter/book/editorial/short survey/book series	106
not relevant (non-education topics and non for EC)	56
Total	428

Analytical Tool

This study uses a bibliometric analysis technique consisting of performance analysis, science mapping and a bibliometric network. The information obtained from this technique includes the number of citations, co-occurrence, co-authors and others. The main analytical tool used to map GBL research trends in this study is VOSviewer version 16.18, released on January 24, 2022.

Bibliometric analysis is generally used in certain disciplines and is a study with a quantitative approach to journal articles, books or other types of written publications (Perianes-Rodriguez et al., 2016). For this activity, there are four general steps in bibliometric

analysis (Donthu et al., 2021). The four steps include defining the purpose and scope of the search by defining keywords such as "game based learning", selecting the techniques used for bibliometric analysis, and collecting and analyzing data.

Collect The Data for Bibliometric Analysis

Data collection in this study was carried out using the scopus.com literature search web. From the original 428 articles, we pulled 256 papers from leading journals based on the Scimagojr website. After examining the titles and abstracts, 172 articles were excluded for various reasons (Table 1).

Analysis Data

Data analysis in this paper uses descriptive analysis, which quantitatively describes the research question using VOS viewer version 16.18.

RESULT & DISCUSSION

Classification of papers on game-based learning. We analysed the output of the Scopus database, which had been screened with inclusion and exclusion criteria using VOS viewer software to determine what keywords often appeared. The VOS viewer tool was developed by van Eck and Waltman in 2010 (see http://www.vosviewer.com) and used to visualize bibliometric maps. The software shows bibliometric mapping on three different visualizations, network visualization, overlay visualization, and density visualization. VOSviewer can classify keywords into different groups.

The article dataset was extracted from the title and abstract, using a full count with the minimum number of occurrences set to 5, resulting in 804 keywords and 28 items meeting the threshold. No keywords were excluded from this analysis because the selected keywords were author keywords. Three clusters have been identified in this process, indicated by the colours red, green, and blue (figure 1). The first cluster in red consists of 10 elements, with the most frequently used terms being 'serious games' (21 occurrences), serious game (18 occurrences), 'children' (19 occurrences), and 'learning' (9 occurrences). The second cluster in green has 10 items consisting of 'game-based learning' (32 occurrences), 'gamification' (24), 'early childhood (15) and 'preschool children (9 occurrences). The third cluster in blue identifies the other 4 words that occur most frequently, with the most common being 'educational games (21), followed by 'early childhood education (17 occurrences), 'kindergarten' (16 occurrences) and 'educational games' (15 occurrences). The keywords in each cluster represent the flow of research on game-based learning in early childhood. Detailed information is presented in Table 5. The keywords in each cluster represent the flow of research on game-based learning in early childhood. Detailed information is presented in Table 2. The keywords in each cluster represent the flow of research on game-based learning in early childhood. Detailed information is presented in Table 5.

GBL Research Trends in Early Childhood. This study reviews a data set of 256 articles with game-based learning themes. Articles were collected from the scopus.com database. These 256 articles are drawn from the original larger collection of 428 articles.

Each cluster generated in the bibliometric analysis using VOSviewer shows a trend in studies related to game-based learning in early childhood, which the occurrence of these terms can represent. In cluster 1 as the main cluster, it is possible to represent experimental type research. Cluster 2 represents various research types, qualitative and quantitative, and even mixed methods. Cluster 3 represents research and development. With these facts, this paper may respond to a second research question about developing game-based learning research in early childhood studies. In other words, the research that is mostly done on this topic is experimental, followed by research and development.

Future GBL topics in early childhood provide opportunities for more research. The bibliometric analysis of this topic answers questions about the topic of further research. The visualization shown through network visualization in Figure 1 describes future research opportunities. The size of the nodes for each keyword that appears in the network visualization illustrates the number of occurrences of that topic in game-based learning in early childhood studies. 'Game-based learning', 'educational game' and 'serious game' are the words that occur most frequently and represent each cluster. These three keywords have almost the same size of nodes because these three keywords are synonyms and have become the main topic of this paper.

Table 2. Classification by Keyword

Cluster 1	Occurrences	Total link strength
Autism	7	8
Children	19	19
Education	8	13
Game	6	8
games	6	7
intervention	6	9
learning	9	15
preschool	8	10
serious game	18	13
serious games	21	17

Cluster 2	Occurrences	Total link strength
computational thinking	5	8
digital games	6	8
early childhood	15	20
game-based learning	32	25
gamification	24	19
language learning	6	8
mobile learning	6	8
preschool children	9	13
preschool education	5	5
young children	5	5

Cluster 3	Occurrences	Total link strength
augmented reality	5	9
digital games-based learning	7	10
early childhood education	17	19
educational game	15	9
educational games	21	22
game design	9	10
human computer interaction	6	2

The terms 'Computational thinking', 'augmented reality, and 'human-computer interaction' are some of the words that are rarely used. Nodes indicate this with small sizes in the network visualization (figure 1). It illustrates that research on early childhood with this term is minimal. Even in the Scopus database as an indexer of internationally reputed journals, there are only 5-6 studies related to this topic. These topics need attention and need to be recommended for future studies. In addition, the topic of gamification is a popular topic in recent years related to early childhood education (figure 2).

The term "human-computer interactions" is one fascinating aspect of this study. Figure 1 shows that the network built for the topic "human-computer interaction" is still relatively weak and includes just a small number of occurrences (figure 1). This report was published in 2016, which is a long time ago. However, there may be more research to be done on this subject.
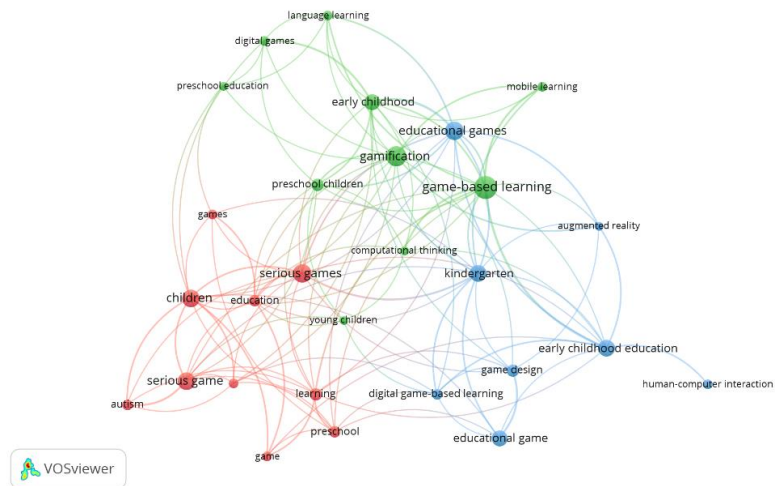

Figure 1. Network Visualization Game-Based Learning in Early Childhood Studies
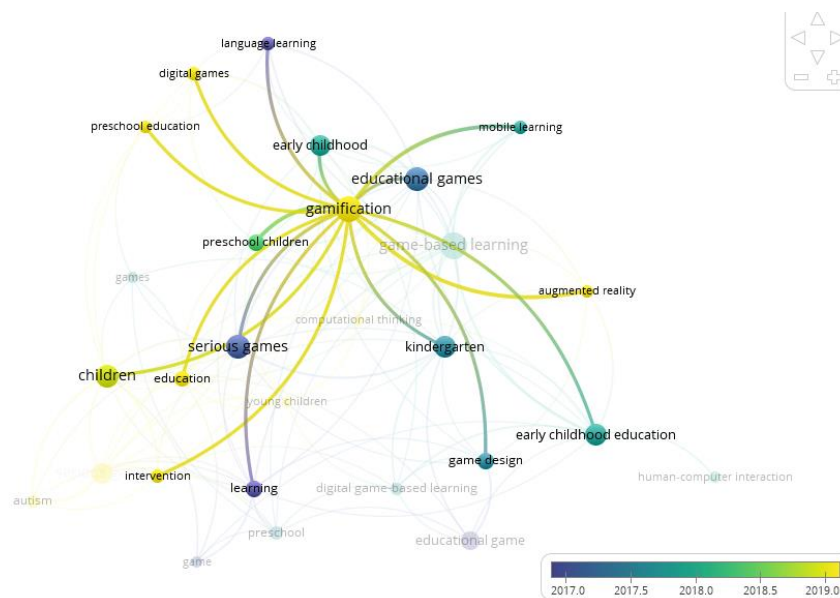
Figure 2. Overlay Visualization Game-Based Learning in Early Childhood Studies

Based on the findings above, it can be concluded that research on computational thinking and human-computer interaction has a great opportunity for future research in early childhood studies. What researchers, educators and game developers need to consider is an in-depth analysis to test the effectiveness of the interaction mechanism. In addition, of course, the effectiveness of learning, emotions and user adaptation (Nacher et al., 2016).

CONCLUSION

The research on game-based learning is mostly experimental, followed by research and development. Topics that can be said include minimal emergence, and the network formed is still very weak in the bibliometric analysis, providing opportunities for further research, especially on human-computer interaction.

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