



## Examining Studies Containing Digital Games in the Field of Science Education: A Bibliometric Analysis

İclal ALKAN SUCU<sup>1</sup>, Gülşah DEMİRCİ<sup>2</sup>

### Abstract

The aim of this research is to try to reveal the general trend in this field by performing a bibliometric analysis of digital game studies in the field of science education. Thus, it was carried out in accordance with the descriptive research design, which allows the data obtained from the research to be made more meaningful by nature and presented in a way that can be easily understood by other researchers who will work in the field. Within the scope of the research, the Web of Science (WoS) database was accessed and the keyword "digital game in science education" was scanned in the title. In this context, in the scan carried out on 14.05.2024, it was seen that there were a total of 706 studies containing the relevant key concept since 2005. Within the scope of the study, research on digital games in science education was examined in terms of content and bibliometrics. As a result of the analysis, features such as general trends in the relevant field, authors who conducted studies and the distribution of studies by years are shown with tables, graphs and figures. In the research, it was determined that the distribution of the works in WoS by years was between "2005-2024" and the most productive author was "Gwo Jen Hwang". It was determined that the most studies in the distribution according to WoS categories were in the "Education/Educational Research" category. It has been concluded that the university with the most publications on the relevant subject is "National Taiwan University of Science and Technology" and the country with the most publications is "The United States of America". According to the common word analysis, it was observed that the most frequently repeated keyword in the studies was "digital games", according to the type of publication, the most studies were published in the article type, and in the distribution according.

### Key Words

Science education  
Digital game  
Bibliometrics

### About Article

Sending date: 05.08.2024  
Acceptance date: 08.10.2024  
E-publication date: 31.12.2024

<sup>1</sup> Assist. Prof. Dr., İnönü University Faculty of Education, Türkiye, [iclal.alkan@inonu.edu.tr](mailto:iclal.alkan@inonu.edu.tr), <https://orcid.org/0000-0002-7348-3280>

<sup>2</sup> Teacher, Ministry of National Education, Türkiye, [37231401005@ogr.inonu.edu.tr](mailto:37231401005@ogr.inonu.edu.tr), <https://orcid.org/0009-0006-1026-1070>

## Introduction

“Education is the process of bringing about a desired change in an individual's behavior through his or her own experiences” (Ertürk, 1997). In this process, we encounter the concept of teaching in order to achieve the desired goals. Erden (2007) defines teaching as "planned, controlled and organized teaching activities carried out in schools". An effective teaching environment must include the teacher, the learner, the teaching environment and elements that support this environment. The more interesting this environment is, the more permanent the learning will be. An individual's educational life and, accordingly, his status and social environment in society are affected by education (Uskan and Bozkuş, 2019). An effective educational environment includes seeing, hearing, doing, multimedia, cooperation, positive motivation, low stress, and fun (Demirel, 2002). Increasing students' motivation in this environment makes them more willing to participate in the learning process (Spires, 2015). Games are a set of planned or unplanned activities that have been used in different areas of education from past to present, contributing to personal development, completing education and ensuring the permanence of knowledge (Yıldırım, 2015). “Game is entertainment that develops skills and intelligence, has certain rules, and helps to have a good time” (TDK). Games can strengthen bonds between people and allow people to have a good time. It also engages players physically and mentally, helping them develop various skills such as problem solving, teamwork, social interaction, concentration, memory, and creativity (Özyürek and Çavuş, 2016).

Using technology in education has the potential to improve teaching and learning processes (Rehmat and Bailey, 2014). The transition from traditional games to digital games is a natural process that occurs with technological developments. In addition to having a fun time, digital games are an important phenomenon in which life is experienced, increases a person's creativity, strategic thinking skills, supports his intellectual and spiritual development, habits and character, and enables socialization (Sağıroğlu et al., 2022). The development of technological devices such as computers has made it possible to move games to digital environments. Digital games can be played on different electronic devices such as computers, game consoles, smartphones and tablets. They are interactive, multi-player games that are generally built around a story and scenario. Players control their characters, facing various challenges to complete certain tasks. These games can provide an interesting and entertaining experience for students of all ages (Uluay, 2017).

Digital games have become a popular tool for learning in recent years. They provide a fun and engaging way to learn. Digital games for students improve skills such as (Ağırçöl et al., 2022);

- Problem-solving,
- Critical-thinking,
- Decision-making,
- Discovery,
- Initiative.

One of the most important benefits of digital games is the ability to provide instant feedback. This strengthens learning and encourages students to learn new things. Digital games are compatible with individual learning styles. This makes it an effective tool for differentiated instruction. Digital gaming also encourages collaboration and social interaction. It directs students to work together to achieve a common goal. It helps make learning more interesting (Ağırçöl et al., 2022). Factors affecting the spread of digital games include technological developments, the spread of mobile devices, increased internet access, social media, popular culture, and education. Thanks to developing technology, sound effects, game graphics and gameplay have become more realistic (Pala and Erdem, 2011). The spread of smartphones and mobile devices has accelerated the spread of digital games. Mobile devices allow people to play games anywhere, anytime. The spread of the Internet has enabled games to be played online. In this way, people all over the world can play games together (Taş and Taş, 2021). Social media provides a marketing and promotional platform for game developers. This has enabled digital games to be played by more people. Digital games have become a part of popular culture. Movies, TV programs, and music often reference digital games, attracting attention and contributing to their increasing popularity. Similarly, the use of digital games in education and learning has further promoted their widespread adoption. Games attract students' attention by making learning more fun (Karataş, 2014;

Kim, 2015). Many researchers working in the field of educational technology, regarding the use of digital games for learning purposes have conducted research on topics such as digital games and creativity (Hsiao et al., 2014), interaction (Kline, 2003) and increasing problem-solving motivation (Soute et al., 2010). It is clear that digital games will be beneficial to children who play games for fun or learning in the 21st century in terms of self-realization in areas such as learning, education and social interaction (Selwyn and Odabaşı, 2017). Digital games contribute greatly to child development. It can be said that it is beneficial for the development of skills such as strategic thinking, quick decision-making, problem-solving and critical-thinking. All these skills have become an integral part of education today. Both the increasing importance given to scientific process skills and the rapidly spreading technological developments all over the world have also affected science education research. What has been done in the field and the general trend of these studies will guide future research. In this way, it is seen that analysis studies are necessary to increase scientific literacy, which is one of the main goals, and to obtain productive results from scientific research in the short term (Dölek and Koç, 2022). Although methods such as meta-analysis, meta-synthesis, descriptive analysis, and content analysis are used as analysis methods, one of these methods is bibliometric analysis used in the study. Bibliometric studies create solid foundations for the development and advancement of the field of science covered in the research, as they help researchers obtain a single-point perspective, identify knowledge gaps, generate new ideas for research, and determine their contributions to the field, and are distinguished from other analysis methods in these aspects (Donthu et al., 2021).

Bibliometrics examines scientific publications, such as journals, books, and articles, focusing on aspects like “subject,” “year,” “keywords,” “number of authors,” “citations,” “common citations,” etc. It can be defined as a set of methods that provide some clues about the relevant discipline, field, subject, institutions, countries, authors and collaboration between authors by examining their characteristics (Al and Tonta, 2004; Ukşul, 2016; Zan, 2012).

By examining the different bibliometric properties of studies published in an academic field using bibliometrics; it is possible to make comparisons on many subjects, to determine the usage rates of scientific communication tools, identify the most effective authors in the field, and to evaluate a journal (Yalçın, 2010). Bibliometric methods do not replace traditional compilation methods, but can be complementary. Even when used in a specific way, they can provide the researcher with useful information about the research field (such as important publications, authors, structure of the field, etc.). While bibliometric methods can be used in independent bibliometric analysis articles, they can also provide additional information for use in structured literature reviews (Zupic and Cater, 2015, p. 436). Bibliometric analysis is used in mathematical and statistical analysis of articles and theses, especially those belonging to certain databases. The aim of bibliometric analysis is to increase the efficiency of information, and for this purpose, the mobility of scientific information is examined (Yalçın and Esen, 2016). As in many fields, bibliometric analyzes are carried out on different topics in the field of educational sciences. When the studies are examined, science education (Bakır et al., 2023; Demir and Çelik, 2020; Orhan and Aydın, 2022; Özdil, 2021; Yurdakul and Bozdoğan, 2022) and digital games (Ağrgöl, 2020; Akgül and Kılıç, 2020; Halaç and Ögülmüş, 2023) studies in which separate bibliometric analyzes were made in the fields were observed, but no bibliometric analyzes related to "digital games in science education" were found. Considering that science education has an important place in the development of countries, it seems that there is a need for qualified studies that will guide researchers in this field. In this context, it is envisaged that the study will guide future studies by conducting a bibliometric analysis of international articles published in the field of digital games in science education. Based on this, the aim of the study was defined as a bibliometric analysis of digital game-based research in the field of science education.

### ***Purpose of the research***

Considering the rapid increase in studies in the field of technology and science education, it is observed that there is a need for qualified studies in order to guide researchers in this field. It is thought that this research will guide future studies by conducting a bibliometric analysis of international studies involving digital games in the field of science education. Based on this, the aim of the research is determined to reveal the tendencies and trends in the field by examining digital game studies in the field of science education from a bibliometric perspective.

Within the scope of the research, answers were sought to the following questions:

1. What are the Web of Science (WoS) categories for publications identified using the keyword “digital games in science education”?
2. What types of publications are related to digital games in science education?
3. What is the numerical distribution of studies on digital games in science education by year?
4. What is the keyword network of studies on digital games in science education?
5. What languages are used in the publications on digital games in science education?
6. Who are the researchers active in the studies published on digital games in science education?
7. Which countries are involved in the studies published on digital games in science education?
8. Which institutions are involved in the studies on digital games in science education?

## Method

### *Research Model*

This study aims to reveal the bibliometric profile of studies involving digital games in the field of science education. Descriptive and bibliometric analysis was conducted for this purpose. The descriptive analysis part of the study consists of creating frequency and percentage parts using WoS data. The aim of descriptive analysis is to organize and interpret the obtained findings and convey them to the reader. For this purpose, first the obtained data is described clearly and then these descriptions are explained, interpreted and examined (Yıldırım & Şimşek, 2011). In the bibliometric analysis part, which is the quantitative part of the study, VOS-viewer software, one of the visual mapping methods, was used. Bibliometric analysis reveals the dynamics, general characteristics and trends of a specific journal, subject or discipline (Besimoğlu, 2015).

### *Data Collection*

In this study, which aims to conduct a bibliometric analysis of studies conducted in the field of digital games in science education, a search was conducted in the WoS database using the keyword “digital games in science education”. Accordingly, as of May 14, 2024, it was found that there were 706 studies since 2005. The WoS database, with its global geographical coverage and high impact quality, provides researchers with access to basic metadata such as publication abstracts, references, citation counts, author lists, authors' institutions, countries, and journal impact factors (Brito-Ochoa et al., 2020; Wang et al., 2022).

### *Data Analysis*

The data obtained from 706 scientific studies on “digital games in science education” in the WoS database were downloaded as “tab limited file” and “excel” files. Descriptive content analysis was conducted via the WoS website. Using the VOS-viewer 1.6.18 software program, visual maps for some findings were created. VOS-viewer is a software tool used to create maps based on network data, visualize and explore these maps. Originally designed to analyze bibliometric networks, this software program can be used in various network data-based studies (Tuncer et al., 2022; Van Eck & Waltman, 2010).

## Findings

### *Web of Science (WoS) Categories*

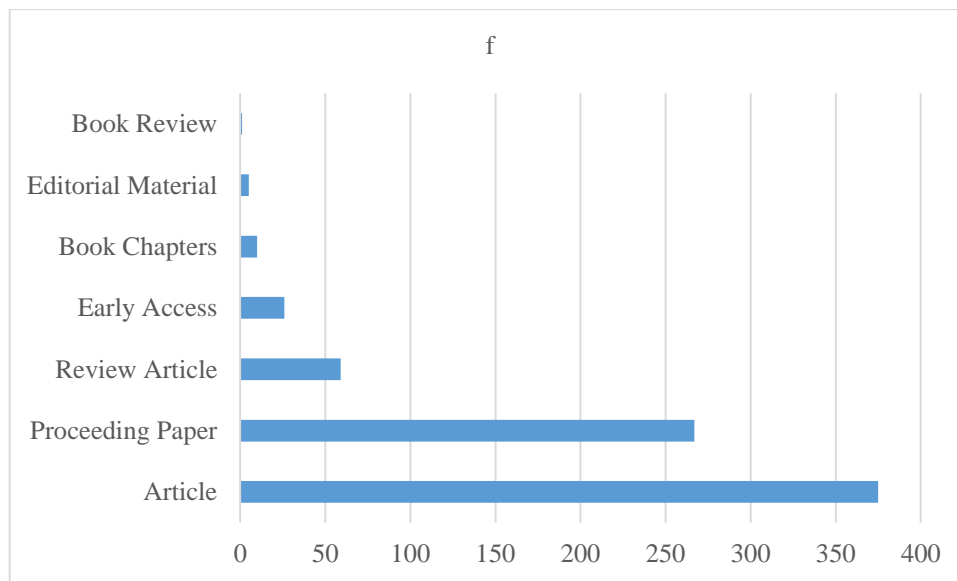
The distribution of publications on digital games in science education according to WoS categories is given in Table 1. As can be seen from Table 1, it was observed that the most studies were in the “Education/Educational Research” category (f=340). This category is followed by “Computer Science Interdisciplinary Applications” (f=140) and “Computer Science Software Engineering” (f=83), respectively.

**Table 1.** Web of Science (WoS) categories of studies on digital games in science education (WoS, 14.05.2024)

WoS Categories	Frequency (f)	Percentage (%)
Education & Educational Research	340	34,5
Computer Science Interdisciplinary Applications	140	14,2
Computer Science Software Engineering	83	8,4
Computer Science Theory Methods	82	8,3
Computer Science Information Systems	67	6,8
Education Scientific Disciplines	62	6,1
Computer Science Artificial Intelligence	47	4,6
Computer Science Cybernetics	45	4,5
Engineering Electrical Electronic	38	3,8
Public Environmental Occupational Health	33	3,3
Communication	25	2,5
Social Sciences Interdisciplinary	21	2,1
Total	983	100

### *Publication Types*

The relationship between the studies on digital games in science education conducted to date and the types of publications is given in Figure 1. As observed in Figure 1, publications on digital games in science education have been carried out in seven different ways according to their types (Article, report, compilation, book chapter, editorial material, book review). In terms of publication type, the most published studies were articles ( $f=375$ ) and reports ( $f=267$ ). These publications are followed by compilation studies ( $f=59$ ), early-stage publications ( $f=26$ ) and book chapters ( $f=10$ ).

**Figure 1.** Publication types of studies on digital games in science education (WoS, 14.05.2024)

### *Numerical Distribution of Publications by Year*

The numerical distribution of studies on digital games in science education by year is shown in Figure 2.



According to Figure 3, when the minimum number of words was selected as five among 1912 keywords, 70 of the words met the threshold value and were grouped under five clusters. According to the visualized network map; digital games, game-based learning, education, gamification, learning are the most frequently used keywords. In addition, physical activity, health education, bibliometric analysis, video game, learning motivation keywords are among the least preferred.

### **Publication Languages**

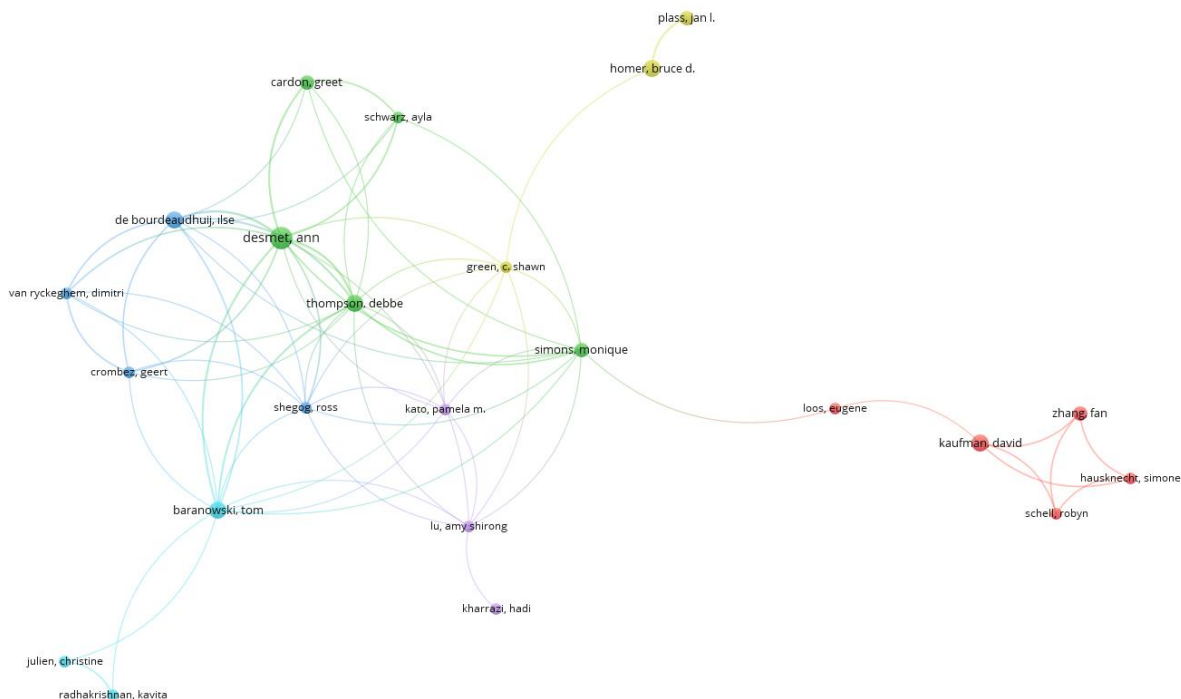
The distribution of studies on digital games in science education, categorized by publication language, is presented in Table 2.

**Table 2.** Distribution of published studies on digital games in science education by publication language (WoS, 14.05.2024)

Languages	Frequency (f)	Percentage (%)
English	687	97.3
Portuguese	11	1.55
Spanish	3	0.42
Chinese	2	0.28
Bulgarian	1	0.14
Norwegian	1	0.14
Ukrainian	1	0.14
Total	706	100

As seen in Table 2, published studies on digital games in science education were published in 7 languages in total and predominantly in English (f=687). English was followed by Portuguese (f=11), Spanish (f=3), Chinese (f=2) and other languages (Bulgarian, Norwegian and Ukrainian).

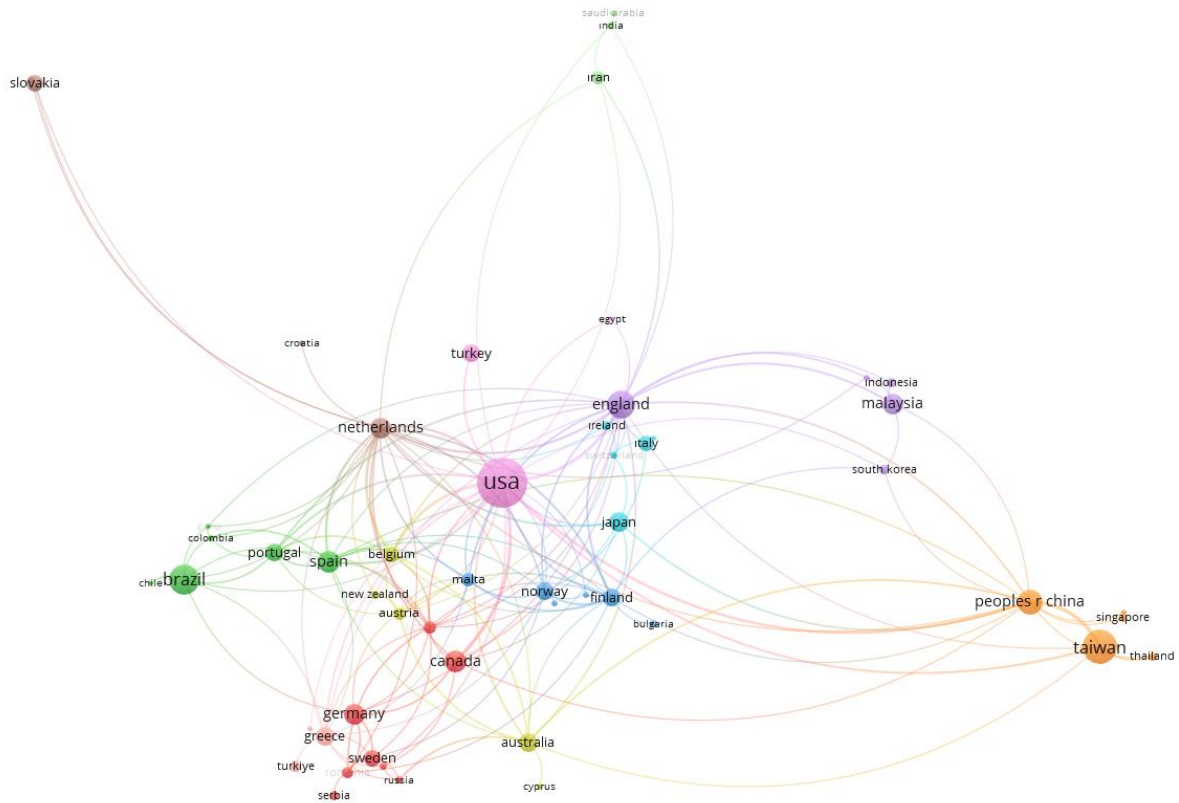
### **Researchers Active in Studies Published on Digital Games in Science Education**



**Figure 4.** Network mapping of researchers active in studies published on digital games in science education (WoS, 14.05.2024)

When the network visualization map of researchers active in studies published on digital games in science education in Figure 4 is examined, it is observed that the author with the most publications is Douglas B. Clark (f=11). This author is followed by Peter Mozelius (f=8), Ann Desmet (f=7) and others [Haoran Xie, Di Zou and Pratim Sengupta (f=7)].

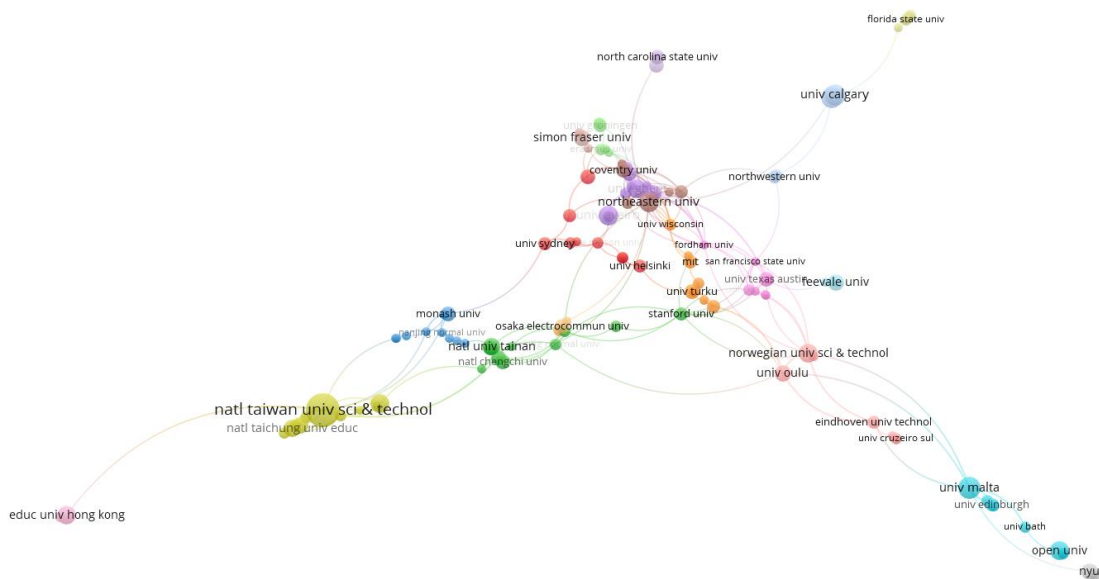
**Countries Active in Published Studies on Digital Games in Science Education**



**Figure 5.** Network mapping of countries active in published studies on digital games in science education (WoS, 14.05.2024)

When the network mapping of countries active in published studies on digital games in science education is examined, the country with the most studies is the United States (f=155). This is followed by Taiwan (f=72), Brazil (f=56), England (f=49), China (f=40), Spain (f=31) and Canada (f=31).

**Institutions Active in the Scope of Published Studies on Digital Games in Science Education**



**Figure 6.** Network mapping of institutions active in the scope of published studies on digital games in science education (WoS, 14.05.2024)



According to Figure 6, when the distribution of institutions active in the scope of published studies on digital games in science education is examined, it is observed that the university with the most publications is “National Taiwan University of Science and Technology” (f=25). Other universities are determined to be “University of Malta” (f=11), “The University of Calgary” (f=10), “Vanderbilt University” (f=10), respectively.

### Discussion, Conclusion and Suggestions

In this study, scientific studies on digital games in the field of science education between 2005 and 2024 were examined in the articles in the WoS database. When the literature was examined, it was seen that there was no bibliometric analysis conducted for studies that included the key concepts discussed in the research in the field of science education. Therefore, the study conducted has the feature of being the first bibliometric analysis conducted in the WoS database in the relevant field. When the WoS categories of the study were examined, it was observed that the studies were mostly in the "Education/Educational Research" category. Studies in this field have shown that digital technology, especially gamification, is effectively used to improve students' learning skills in science education (Gui et al., 2023). The use of digital games in education, especially in the context of computer memory principles, has been found to be more effective in improving students' understanding and motivation compared to non-game approaches, and the educational value and motivational appeal of such interventions has been demonstrated in secondary education (Yeşiltaş and Cevher, 2022).

When the studies conducted in the field of digital games in science education were examined according to the type of publication, it was seen that the most studies were articles and papers. It is thought that the fact that studies on digital games in science education are mostly published as articles reflects the increasing interest in this field. A study conducted using bibliometric analysis on digital game-based learning in science and mathematics education revealed that the majority of the publications were articles that focused on increasing student motivation and participation while reducing learning anxiety (Pei-Ying et al., 2021). Similarly, in a study examining the use of digital games in education, it was determined that most of the studies were articles published in 2017 and 2018, which shows that this publication type is preferred in the field of digital game-based learning (Ergin and Ergin, 2022). In addition, a broader analysis of game-based learning in various disciplines revealed that articles were the primary publication type, which emphasized the importance of articles in disseminating research findings on digital games in education (Küçükaydın and Durmaz, 2022).

When the scientific studies on digital games in the relevant field are examined by years in the context of the determined criteria, it is seen that they have gradually increased since 2005, and the number of studies, which was 3 this year, reached the highest number with 86 in 2017. Digital games started to become widespread among children and young people in 2003. In 2005, the digital game market developed by starting to produce new generation consoles (Karaduman and Aciyan, 2020). It is thought that the COVID-19 virus has been effective in the increase in studies on "digital games" in 2021. It is thought that the tendency towards digital games as a way of coping with problems has increased especially in children and young people. According to the April 2020 digital usage data published jointly by “We Are Social”, a global social media agency, and “Hootsuite”, a social media management tool, individuals spent 35% of their time playing computer or video games during the COVID-19 outbreak (WEB-1, 2022). Due to the increase in the use of digital gaming tools, Türkiye ranked sixth in the world, with 91.5% of its population playing video games, according to the January 2022 report by “We Are Social” (WEB-2, 2022). In this field, a study conducted by Yeşiltaş and Cevher (2022) examining the research trends on the use of digital games in education between 2005-2021 using the bibliometric analysis method reached a similar conclusion, and it was stated that the number of studies was the highest in 2017-2018. It is thought that the use of educational games in the education-training process means, in a sense, the use of technology in this process. In this context, when similar studies on the use of technology in the education-training process are examined, it is seen that the relevant technologies tend to increase in this process, especially since the beginning of the current century. For example, in the bibliometric analysis conducted by Hao et al., (2020) on the use of technology in teaching classroom dialogue, it was concluded that these technology-supported applications in the relevant field have increased rapidly in the last 20 years. In the bibliometric analysis conducted by Liu et al. (2017) in order to reveal the use of virtual reality applications in the field of education and the general trend, it was

concluded that the studies carried out in the relevant field have increased exponentially since 1995. In the study conducted by Rodríguez Jiménez et al. (2019) which carried out the bibliometric analysis of publications on the use of technology in higher education, it was reported that there has been a significant increase in the number of studies published in the relevant field in recent years on the use of technology. In another study aiming to conduct a bibliometric analysis of scientific studies published on educational technologies in the last 40 years (Chen et al., 2019), it was stated that there has been a significant increase in the number of studies carried out on the relevant subject especially after 2005. Although the studies conducted in this context are not directly related to the purpose of this study, they are considered important in terms of revealing that there is an increase in the use of technology in the education-training process over the years. In this case, it is seen that the research findings obtained overlap with the findings obtained in the studies conducted.

When examining the distribution of studies on digital games in science education based on the number of publications per author, it is observed that Gwo Jen Hwang is the most prolific author. He is followed, respectively, by Douglas B. Clark, Peter Mozelius, and others, including Ann Desmet, Haoran Xie, Di Zou, and Pratim Sengupta. The study reached similar results with the findings of the studies conducted by Ergin and Ergin (2022), and Yeşiltaş and Cevher (2022). “A collaborative, game-based learning approach to improving students' learning performance in science courses” (Sung and Hwang, 2013); “The effects of digital game-based STEM education on students' learning achievement: a meta-analysis” (Wang et al., 2022) are some of Hwang's studies on digital games in science education. It is seen that Hwang has made a great contribution to the field in this sense.

When the distribution of relevant studies by country is examined, the country with the most studies is the United States. This is followed by Taiwan, Brazil, England, China, Spain and Canada, respectively. Kuzu and Kuzu (2022), and Karagöz and Ateş (2022) reached similar results in their studies. In addition, in studies where bibliometric analysis of studies conducted in the literature and generally addressing the use of technology in the education-training process is conducted, it is seen that the leading countries are generally reported as the United States, Taiwan and China (Chen et al., 2019; Khan and Gupta, 2021; Liu and Zhang, 2021; Rodríguez Jiménez et al., 2019). It is thought that many factors such as the countries' ability to integrate technology in their education-training processes, the financial resources allocated to the field of education-training and the demographic characteristics of the country's population may be effective in the emergence of this situation.

As a result of this distribution by country, it is seen that the distribution of published articles in terms of language is predominantly English. It is thought that this situation is caused by the region/country and university where the publications are made, as well as the fact that the mentioned journals accept publications in this language and that English is accepted as the language of science today.

When the frequency of co-occurrence of key concepts included in publications is examined, it is determined that the most frequently used keywords belong to the concepts of “digital games” and “game-based learning”. This finding reveals that the most frequently used key concepts in studies in the field of digital games in science education are “digital games” and “game-based learning”. In addition, after these most frequently used keywords, education, gamification, learning are the most frequently used keywords and it is concluded that they are concepts with high connection power for relevant publications. Based on this, it is thought that the key concepts selected to reach relevant studies while conducting this study are the right choice in terms of reaching relevant publications, and it will be advantageous for researchers planning to conduct research in the relevant field to prioritize these key concepts in the literature review.

When the distribution of studies on digital games in science education by institutions is examined, it is seen that the university with the most publications is the "National Taiwan University of Science and Technology". It is thought that the fact that Gwo Jen Hwang, who has done the most research in the field of digital games in science education, is also at this university and carries out his studies there, brings the name of the "National Taiwan University of Science and Technology" to the fore in this field. Similar results were reached in the studies titled "Trends in the field of digital game-

based learning" by Karagöz and Ateş (2022) and in the study titled "Examination of studies on digital games: A bibliometric analysis" by Ergin and Ergin (2022).

### ***Limitations***

It is also important to consider some limitations within the scope of this study. In the study carried out in order to contribute to the relevant field, the data were obtained by first examining the key concepts expressed in the specified database under the title and limiting it to the studies carried out since 2005 in the field of digital games in science education. In this context, other studies planned to be carried out in the field can be re-analyzed and reported outside the context of these limitations. In addition, another important limitation is that publications in other databases that are not included in the relevant database can be included in the analysis and the scope of the study can be expanded, contributing to the degree of generalizability of the results obtained. Another limitation can be evaluated as the year range in which the examination was carried out. Taking 2005 as the starting year of the examination, it is seen that there was no significant fluctuation in the number of publications made before the relevant year and that the publications containing the key concepts determined in the relevant field showed a rapid increase after this year. In this context, it is thought that a similar study can be carried out for the general trends of the subsequent publications after a while after the date of 14/05/2024 when the examination was carried out. On the other hand, the data were obtained by examining the relevant key concepts only in the title. It is thought that a similar study can be designed by performing a more comprehensive examination and analysis in order to reach other publications in the relevant field but not including these key concepts in the title. As a result, the general tendency of scientific articles published on digital games in the field of science education was tried to be described by using the specified keywords in the WoS database in the current study. It is thought that this study will guide researchers in terms of basic points for future studies planned to be carried out on digital games in the context of science education.

### ***Recommendations***

- In this study, the keyword “digital games in science education” was used in the WoS database. Searches could also be conducted using other relevant keywords.
- The data in the study was obtained as of 14/05/2024 and 2005 was limited as the start year. An earlier date can be selected as the start year.
- Only the WoS database was used to obtain the data. Other databases can also be used.
- The sub-problems of the study were limited to the publication language of the studies in the relevant field, publication year, researchers, institutions, WoS categories, publication types, keywords, and countries. Research can also be conducted in other categories.

### ***Research and Publication Ethics***

In the study conducted, all rules specified in the “Higher Education Institutions Scientific Research and Publication Ethics Directive” were followed. None of the actions specified in the second section of the directive titled “Actions Contrary to Scientific Research and Publication Ethics” were carried out.

### ***Ethics Committee Permission***

Since no data was obtained from any living being in any way within the scope of the scientific study conducted, there was no need for an ethics committee decision.

### **References**

- Ağırçöl, M. (2020). The effect of using educational digital games in science education on students' academic success, knowledge retention and attitude (Master's thesis, Institute of Science).
- Ağırçöl, M., Kara, E., & Akgül, G. D. (2022). The effect of science course taught with educational digital games on students' knowledge retention, academic success and attitude. *International Journal of Science and Education*, 5(3), 157-176. <https://doi.org/10.47477/ubed.1063920>
- Akgül, G. D., & Kılıç, M. (2020). Opinions of science teacher candidates on educational digital games and code application. *Journal of Science Education*, 8(2), 101-120. <https://dergipark.org.tr/en/pub/fbod/issue/71992/1158003>

- Al, U., & Tonta, Y. (2004). Citation analysis: Sources cited in Hacettepe University Librarianship Department Theses. *Information World Journal*, 5(1), 19-47. <https://doi.org/10.15612/BD.2004.497>
- Bakır, S., Zorluoğlu, S. L., & Ulusoy, T. (2023). Bibliometric Analysis of Studies in Science Education and Neuroscience. *Mehmet Akif Ersoy University Faculty of Education Journal*, (67), 52-70. <https://doi.org/10.21764/maeuefd.1263640>
- Besimoğlu C. (2015) Agricultural research trends of agricultural faculties in Turkey: Bibliometric analysis of life sciences database publications between 1996-2011. *Bilgi Dünyası*, 16(2), 242-274. <https://doi.org/10.15612/BD.2015.499>
- Brito-Ochoa, M. P., Sacristán-Navarro, M. A. & Pelechano-Barahona, E. (2020). A bibliometric analysis of dynamic capacities in the field of family firms (2009-2019). *European Journal of Family Business*, 10(2), 69-81. <https://doi.org/10.24310/ejfbefjb.v10i2.10162>
- Chen, X., Yu, G., Cheng, G., & Hao, T. (2019). Research topics, author profiles, and collaboration networks in the top-ranked journal on educational technology over the past 40 years: a bibliometric analysis. *Journal of Computers in Education*, 6(4), 563-585. <https://link.springer.com/article/10.1007/s40692-019-00149-1>
- Demir, E. & Çelik, M. (2020). Bibliometric profile of scientific studies in the field of science curriculum. *Turkish Chemistry Association Journal Part C: Chemistry Education*, 5(2), 131-182. <https://doi.org/10.37995/jotcsc.765220>
- Demirel, Ö. (2002). The art of teaching: planning and evaluation in teaching. Ankara: Pegem Academy Publishing
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of business research*, 133, 285-296. <https://doi.org/10.1016/j.jbusres.2021.04.070>
- Dölek S. & Koç A. (2022). Bibliometric Analysis of Scientific Studies on Educational Games. *Journal of Sustainable Educational Studies*, 3(3), 159-179; 2022. <https://dergipark.org.tr/en/pub/seader/issue/71534/1135727>
- Erden, M. (2007). Introduction to educational sciences. Friend publications.
- Ergin, B., & Ergin, E. (2022). Review of Studies on “Digital Games”: A Bibliometric Analysis. *TRT Academy*, 7(16), 824-851. <https://doi.org/10.37679/trta.1142969>
- Ertürk, S. (1997). Program Development in Education. Ankara: Hacettepe University Publications.
- Gui, Y., Cai, Z., Yang, Y., Kong, L., Fan, X., & Tai, R. H. (2023). Effectiveness of digital educational game and game design in STEM learning: a meta-analytic review. *International Journal of STEM Education*, 10(36). <https://link.springer.com/article/10.1186/s40594-023-00424-9>
- Halaç, H. H., & Öğülmüş, V. (2023). Bibliometric Analysis of Theses Containing Digital Games. *Düzce University Journal of Science and Technology*, 11(2), 574-587. <https://doi.org/10.29130/dubited.1026672>
- Hao, T., Chen, X., & Song, Y. (2020). A topic-based bibliometric analysis of two decades of research on the application of technology in classroom dialogue. *Journal of Educational Computing Research*, 58(7), 1311-1341. <https://doi.org/10.1177/0735633120940956>
- Hsiao, H. S., Chang, C. S., Lin, C. Y., & Hu, P. M. (2014). Development of children's creativity and manual skills within digital game- based learning environment. *Journal of Computer Assisted Learning*, 30(4), 377-395. <https://doi.org/10.1111/jcal.12057>
- Karaduman, M. & Aciyan, E. P. (2020). Digital games and addiction in the context of Baudrillard's simulation theory an evaluation on. *Trakya University Journal of Social Sciences*, 22(1), 453-472. <https://doi.org/10.26468/trakyasobed.550935>
- Karagöz, B., & Ateş, H. (2022). Trends in digital games -based learning research: Bibliometric analysis (2001-2021). *Revise online Politica and Educational Gestures*, e022168-e022168. <https://doi.org/10.22633/rpge.v26i00.17726>
- Karataş, E. (2014). Gamification in education: Research trends. *Ahi Evran University Kırşehir Faculty of Education Journal*, 15(2), 315-333. <https://dergipark.org.tr/tr/download/article-file/1490007>
- Khan, F. M., & Gupta, Y. (2021). A bibliometric analysis of mobile learning in the education sector. *Interactive Technology and Smart Education*. <https://doi.org/10.1108/ITSE-03-2021-0048>
- Kim, B. (2015). Designing gamification in the right way. *Library Technology Reports*, 51(2), 29-35. <https://journals.ala.org/index.php/ltr/article/view/5632>
- Kuzu, Y. & Kuzu, Ö. (2022). Bibliometric Analysis of Studies on Educational Games. *Ahi Evran University Social Sciences Institute Journal*, 8(3), 724-740. <https://doi.org/10.31592/aeusbed.1102403>

- Küçükaydın, M. A., & Durmaz, B. (2022). Games in Education: Bibliometric Analysis. In Handbook of Research on Acquiring 21st Century Literacy Skills Through Game-Based Learning (pp. 13-30). IGI Global. <https://doi.org/10.4018/978-1-7998-7271-9.ch002>
- Liu, D., Bhagat, K. K., Gao, Y., Chang, T. W., & Huang, R. (2017). The potentials and trends of virtual reality in education: A bibliometric analysis on top research studies in the last two decades. *Virtual, augmented, and mixed realities in education*, 105-130. [https://doi.org/10.1007/978-981-10-5490-7\\_7](https://doi.org/10.1007/978-981-10-5490-7_7)
- Liu, S., & Zhang, S. (2021). A Bibliometric Analysis of Computer-assisted English Learning from 2001 to 2020. *International Journal of Emerging Technologies in Learning (iJET)*, 16(14), 53-67. <https://www.learntechlib.org/p/220027/>
- Orhan, S. İ., & Aydın, A. (2022). Analyzing the articles published in the fields of science (science, physics, chemistry, biology) and mathematics education using scientific mapping technique: A bibliometric analysis. *Van Yüzüncü Yıl University Journal of Education Faculty*, 19(3), 603-643. <https://doi.org/10.1080/2019. ... .org/10.33711/yyuefd.1083488>
- Özdil, N. (2021). A Look at Science Education Research Between 2000-2020: Bibliometric Analysis of Research from Turkey (Doctoral dissertation, Marmara University (Turkey)). <https://katalog.marmara.edu.tr/veriler/cokluortam/cokluortam/F/A/C/C/B/6217c34f33698.pdf>
- Özyurek, A. & Çavuş, Z. (2016). Investigation of Primary School Teachers' Use of Games as a Teaching Method. *Kastamonu Education Journal*, 24(5), 2157-2166. <https://dergipark.org.tr/tr/pub/kefdergi/issue/27735/316751>
- Pala, F.K. & Erdem, M. (2011). A study on digital game preference and distributions between gender, level and learning style due to game preference. *Ahi Evran University Kırşehir Faculty of Education Journal*, 12(2), 53-71. <https://dergipark.org.tr/en/pub/kefad/issue/59495/855160>
- Chen, P. Y., Hwang, G. J., Yeh, S. Y., Chen, Y. T., Chen, T. W., & Chien, C. H. (2021). Three decades of game-based learning in science and mathematics education: an integrated bibliometric analysis and systematic review. *Journal of Computers in Education*, 1-22. <https://doi.org/10.1007/s40692-021-00210-y>
- Rehmat, A. P., & Bailey, J. M. (2014). Technology integration in a science classroom: Preservice teachers' perceptions. *Journal of Science Education and Technology*, 23, 744-755. <https://doi.org/10.1007/s10956-014-9507-7>
- Rodríguez Jiménez, C., Sanz Prieto, M., & Alonso García, S. (2019). Technology and higher education: A bibliometric analysis. *Education Sciences*, 9(3), 169-177. <https://doi.org/10.3390/educsci9030169>
- Sağiroğlu, Ş., Bülbül, H. İ., Kılıç, A., Küçükali, M., Bayzan, Ş., & Samur, Y. (2022). Dijital games 1. Ankara: Nobel Academic publications.
- Selwyn N. & Odabaşı H. F. (2017). Children and youth's struggles with digital life, H. F. Odabaşı (Editor), *Child in Digital Life*. Ankara. Pegem Academy.
- Soute, I., Markopoulos, P. & Magielse, R. (2010). Head Up Games: combining the best of both worlds by combining traditional and digital games. *Personal and Ubiquitous Computing*, 14, 435-444. <https://doi.org/10.1007/s00779-009-0265-0>
- Spires, H. A. (2015). Digital game- based learning. *Journal of Adolescent & Adult Literacy*, 59(2), 125-130. <https://doi.org/10.1002/jaal.424>
- Sung, H. Y. & Hwang, G. J. (2013). A collaborative, game-based learning approach to improve students' learning performance in science courses. *Computers and education*, 63, 43-51. <https://doi.org/10.1016/j.compedu.2012.11.019>
- Taş, C. Y., & Taş, N. B. (2021). Are hypercasual games played only by young people? A study on the demographic characteristics of video game players. *Iğdır University Journal of Social Sciences*, 10, 22-35. <https://doi.org/10.54600/igdirsosbilder.991820>
- Tuncer, M., Dikmen, M., & Vural, M. (2022). Digital game addiction, behavioral problems and academic performance: A bibliometric mapping. *Journal of Social, Human and Administrative Sciences*, 5(7), 913-933. <https://doi.org/10.26677/TR1010.2022.1035>
- Ukşul, E. (2016). Evaluation of scientific publications in the field of measurement and evaluation in education in Turkey with social network analysis: A bibliometric study (Unpublished master's thesis). Akdeniz University, Antalya.
- Uluay, G. (2017). The effects of digital game design applications in science education on the academic achievement, problem solving skills and motivation of secondary school students. (Thesis No. 485868) [Doctoral dissertation, Gazi University]. National Thesis Center of the Council of Higher Education.

- Uskan, S. B., & Bozkuş, T. (2019). The place of play in education. *International Journal of Current Educational Research*, 5(2), 123-131. <https://dergipark.org.tr/tr/pub/intjces/issue/51237/667992>
- Van Eck, N. J., & Waltman, L. (2010). Software survey: VOS viewer, a computer program for bibliometric mapping. *Scientometrics*, 84(2), 523-538. <https://doi.org/10.1007/s11192-009-0146-3>
- Wang, L. H., Chen, B., Hwang, G. J., Guan, J. Q., & Wang, Y. Q. (2022). The effects of digital game-based STEM education on students' learning achievement: a meta-analysis. *International Journal of STEM Education*, 9(1), 26. <https://hdl.handle.net/20.500.12451/11401>
- WEB-1, (2022). Digital in 2020 global overview. <https://wearesocial.com/blog/2020/04/%20digital-around-the-world-in-april-2020>
- WEB-2 (2022). <https://www.guvenliweb.org.tr/dosya/QHZKc.pdf>
- Yalçın, F. (2010). A study on determining the knowledge levels and misconceptions of primary school students on global warming and greenhouse effect. Master's Thesis. Gazi University Institute of Educational Sciences, Ankara
- Yalçın, H. & Esen, M. (2016). Measuring science: The metrics of science. In H. Yalçın, M. Esen, S. Burmaoğlu, & M. F. Sorkun (Eds.), *Being a Research University in the Age of Science, Technology and Innovation* (pp. 101-128). Pegem Academy
- Yeşiltaş, E., & Cevher, S. (2022). Trends in research on the use of digital games in education. *E-International Journal of Educational Research*, 13(4), 39-56. <https://doi.org/10.19160/e-ijer.1107500>
- Yıldırım, B. (2015). Effect of educational games and feedback-correction on learning level and retention. Master's Thesis, Necmettin Erbakan University.
- Yıldırım, A. & Şimşek, H. (2011). *Qualitative Research Methods in Social Sciences*. Ankara: Seçkin Publishing.
- Yurdakul, M., & Bozdoğan, A. E. (2022). Bibliometric evaluation based on Web of Science database: Articles on science education. *Turkish Journal of Scientific Research*, 7(1), 72-92. <https://dergipark.org.tr/en/pub/tubad/issue/70039/1003790>
- Zan, B. U. (2012). Comparative bibliometric analysis study in scientific branches in Turkey. Unpublished doctoral thesis. Ankara University Institute of Social Sciences, Ankara.
- Zupic, I., & Cater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, 18(3), 429-472. <https://doi.org/10.1177/1094428114562629>

This work is licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/)

