TRENDS IN DIGITAL GAME-BASED LEARNING RESEARCH: BIBLIOMETRIC ANALYSIS (2001-2021)

TENDÊNCIAS NA PESQUISA DE APRENDIZAGEM BASEADA EM JOGOS DIGITAIS: ANÁLISE BIBLIOMÉTRICA (2001-2021)

TENDENCIAS EN LA INVESTIGACIÓN EN APRENDIZAJE DIGITAL BASADO EN JUEGOS: ANÁLISIS BIBLIOMÉTRICO (2001-2021)

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ABSTRACT: The aim of this research is to reveal the global research dynamics of digital game-based learning studies and to contribute to a holistic understanding of the subject area. Within this purpose, the current situation of the field, with its emerging new orientations and its intellectual structure are examined with an in-depth perspective. Bibliometric analysis and social network analysis were performed on 494 publications published between 2001-2021. As a result of the analysis, the publications in the field were first observed in the WoS database in 2001; it has been determined that the publications have been in an increasing trend starting from the period of 2006-2010. In the common keyword analysis, it was seen that the prominent concepts were "digital game-based learning" and "serious games". It was found that the studies were mainly conducted by researchers from Taiwan and the USA.

KEYWORDS: Digital game-based learning. Bibliometrics. Research trends.

RESUMO: *O objetivo desta pesquisa é revelar a dinâmica de pesquisa global dos estudos de aprendizagem baseados em jogos digitais e contribuir para uma compreensão holística da área temática. Dentro deste propósito, a situação atual do campo, com suas novas orientações emergentes e sua estrutura intelectual são examinadas com uma perspectiva aprofundada. Análise bibliométrica e análise de redes sociais foram realizadas em 494 publicações publicadas entre 2001-2021. Como resultado da análise, as publicações na área foram observadas pela primeira vez na base de dados da WoS em 2001; foi determinado que as publicações tiveram uma tendência crescente a partir do período de 2006-2010. Na análise de palavras-chave comuns, observou-se que os conceitos de destaque foram "aprendizagem baseada em jogos digitais" e "jogos sérios". Verificou-se que os estudos foram conduzidos principalmente por pesquisadores de Taiwan e dos EUA.*

PALAVRAS-CHAVE: *Aprendizagem baseada em jogos digitais. Bibliometria. Tendências de pesquisa.*

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RESUMEN: El objetivo de esta investigación es revelar la dinámica de investigación global de los estudios de aprendizaje basados en juegos digitales y contribuir a una comprensión holística del área temática. Dentro de este propósito, se examina con una perspectiva profunda la situación actual del campo, con sus nuevas orientaciones emergentes y su estructura intelectual. Se realizó análisis bibliométrico y análisis de redes sociales en 494 publicaciones publicadas entre 2001-2021. Como resultado del análisis, las publicaciones en el campo se observaron por primera vez en la base de datos WoS en 2001; se ha determinado que las publicaciones han tenido una tendencia creciente a partir del período 2006-2010. En el análisis de palabras clave comunes, se vio que los conceptos destacados eran "aprendizaje basado en juegos digitales" y "juegos serios". Se encontró que los estudios fueron realizados principalmente por investigadores de Taiwán y EE. UU.

PALABRAS CLAVE: Aprendizaje basado en juegos digitales. Bibliometria. Tendencias de investigación.

Introduction

Digital game-based learning (DGBL) refers to a learning method/atmosphere that integrates learning knowledge and skills into digital games and allow students to achieve learning via problem solving and competitive challenges while playing (GROS, 2007). It encompasses digital environments where game content and game play enhance the acquisition of knowledge and skills, and game activities provide players/students with a sense of achievement, include problem areas and solution contexts developed for them (KIRRIEMUIR; MCFARLANE, 2004). These environments pave the way for students to learn how to cope with difficulties and compete with their classmates while solving well-designed simulation problems in the process where game and technology are intertwined. This situation turns the game into a life section that can boost students motivation to learn and thus improve their learning success (PRENSKY, 2001).

Thanks to the introduction of new technologies such as mobile and wireless communication and the advancement of technological communication, it has been observed that digital games are utilized in the context of education to achieve educational objectives and learning software and applications have recently increased the interest in the field (CIAMPA, 2014). Digital games are commonly used as a teaching and learning tool in areas such as mathematics, science, history and language learning (ZIN; JAAFAR; YUE, 2009). Such technologies offer students the opportunity to acquire new skills and competences by taking responsibility for learning, it enables education and training to be improved and developed (HWANG *et al.*, 2013; HWANG *et al.*, 2016). Because of this situation, digital games turn into a powerful educational setting that contributes to learners' use of

communication technologies as a learning tool and to have fun. Within this context, the necessity to understand the effects of new digital technologies on education and to determine the application trends has emerged. From this point of view, it can be said that it is really crucial to examine the studies on DGBL.

Bibliometrics is employed in the longitudinal analysis of the development and distribution of a particular literature. Bibliometrics ensures various findings related to scientific communication by analyzing certain features of documents or publications (AL; COŞTUR, 2007). Within this context, it makes it possible to make inferences about the past, present and future of the fields of study by means of the sources published in a scientific field. In addition, bibliometrics can be used to evaluate the scientific activity of a country as an evidence-based part of research evaluation methodology in scientific and applied fields at the macro level, or to examine a single scientist at the micro level (ELLEGAARD; WALLIN, 2015). Within this respect, it can be mentioned that the research activity in the subject areas is generally exposed through bibliometric analysis and visualization.

When the literature is examined, it can be observed digital game-based learning is used in preschool (GURAN; COJOCAR; DIOSAN, 2020), primary school (HUANG *et al.*, 2020), secondary school (DAI; TAI; NI, 2021), It is noteworthy that it is a subject that is addressed at all levels of education processes such as higher education (USHER; BARAK; HAICK, 2021). In addition, science and mathematics education (CHEN *et al.*, 2021), language education (ZHANG; CHENG; CHEN, 2020), computer education (HWANG; CHEN, 2021), social studies education (HWANG; CHIU; CHEN, 2015), foreign language teaching (CHIU; KAO; REYNOLDS, 2012), teacher education (SOLER COSTA *et al.*, 2020), adult education (WHITTON, 2011), it has been observed that digital game-based learning takes place in the research focus both in sub-fields of educational sciences and in areas outside the scope of educational sciences. In the literature, there are studies investigating the effects on sub-skills such as learning performance (HWANG; YANG; WANG, 2013), attitude (HWANG *et al.*, 2016), self-efficacy (HUNG; HUANG; HWANG, 2014), reading skills (LIU, 2014), critical thinking skills (CHEN; HWANG, 2020). In addition, there are studies examining the field with text mining analysis (MARTÍ-PARREÑO; MÉNDEZ-IBÁÑEZ; ALONSO-ARROYO, 2016), systematic review (CHANG; HWANG, 2019), content analysis methods (AGBO *et al.*, 2021).

This situation reveals a significant recognition of the role that research review articles play in increasing knowledge among DGBL researchers (HALLINGER; KOVAČEVIĆ, 2019). Meanwhile, the bibliometric analysis method is used to provide a broad and

quantitative view of certain sub-areas such as digital learning environments (SCHÖBEL; SAQR; JANSON, 2021), gamification applications in education (SWACHA, 2021), affective perceptions in digital game-based learning (CHEN *et al.*, 2021) has also been found to be used. However, as far as known, there is no study examining the literature by using co-citation analysis, co-occurrence analysis and collaboration network analysis together could be found at the time of the study.

As outlined above, it is considered essential to investigate the latest situation and trends in the field of DGBL through bibliometric analysis and social network analysis in the literature. Since the number of scientific publications on DGBL has been increasing rapidly, which makes it almost impossible for individual researchers to be aware of every publication (TAO; TAN, 2005). On account of this reason, since there is no quantitative research describing the networks of cooperation by revealing the research accumulation and intellectual resources of the DGBL literature, a study was needed. In the study, it is aimed to examine the scientific publications produced in the field from the past to the present in the light of bibliometric data and to determine the global dynamics of the field. Within this respect, the study is crucial in terms of determining the research profile for the field and making inferences about the general appearance. At the same time, the issues that need to be researched in the future, gaps in the field and areas of need can also be defined (MOHER *et al.*, 2015). Accordingly, the findings will provide evidence-based information on the field, it will contribute to constructive discussions by presenting new perspectives in the field. Thus, it will be possible to create a roadmap for the future in terms of the field. Within this respect, determining influential researchers, active journals, effective publications and documents with a longitudinal approach is considered crucial in the context of creating a core information collection (BORNMANN; MUTZ, 2015). It is thought that the study will enable the educational circles to be aware of the global knowledge and trends on the subject. That's why, an information guide that evaluates the research environment in the world in terms of the field will be obtained (CHAO; YANG; JEN, 2007). It is expected that the study will guide young researchers at the beginning of their career, field researchers, and interested readers to this issue, provide new reading lists, and possible future trends for the field that may require further research. Within this context, the research questions are below;

• How do digital game-based learning publications appear in Web of Science in terms of bibliometric features (number of publications, citation trends, institution, author citations)?

• What is the structure of the collaborative network and intellectual view of the digital game-based learning area in Web of Science?

Methodology

Data collection and Data analysis

The main database in this research is Web of Science, which has been selected as it includes high-impact journal publications as well as corresponding bibliometric information such as authors, journals, abstracts, and article citation numbers to be used for bibliometric analyzes in this study (LIN; LEI, 2020) and provides a comprehensive view of published publications related to the field.

To define the conceptual framework of the research, two separate experts determined the main key terms by scanning the theoretical, experimental and literature review studies on the subject. Then, an online inquiry was made on 07 November 2021 in WoS to reach the publications listed in the website. The dataset was prepared using the following keyword group determined by the field experts for the query: TS=("digital game-based learning" OR "Digital Game-Based Learning (DGBL)" OR "DGBL" OR "digital game-based learning (DGBL) environment" OR "digital game-based learning (DGBL) studies") OR TI=("digital game-based learning" OR "Digital Game-Based Learning (DGBL)" OR "DGBL" OR "digital game-based learning (DGBL)) environment" OR "digital game-based learning (DGBL) studies")

WoS data may contain some duplicate records or missing key information. For this reason, necessary precautions have been taken to avoid any duplication or overlap in the records. In this phase, the data set has been cleaned. Consequently, cleaned dataset consisted of 492 documents for analysis.

Bibliometrics and social network analysis were used in the research. Pritchard (1969, p. 348) defines the term bibliometrics as a numerical analysis method that enables the application of mathematical and statistical methods to books and other communication tools. Social network analysis is used to figure out the participants in the content of the field and the relationships between networks, and to map and measure scientific relationships and trends among researchers, groups, organizations or communities (MILOVANOVIĆ *et al.*, 2019). In this study, social network analysis was carried out to examine the field in depth and then describe the intellectual contents (BHATTACHARYA; KUMAR; SINGH, 2020). VOSviewer (1.6.6) software was used for social network analysis in the study.

Publication and citation distribution of research

Figure 1 - Distribution of Publications and Citations of Studies by Years
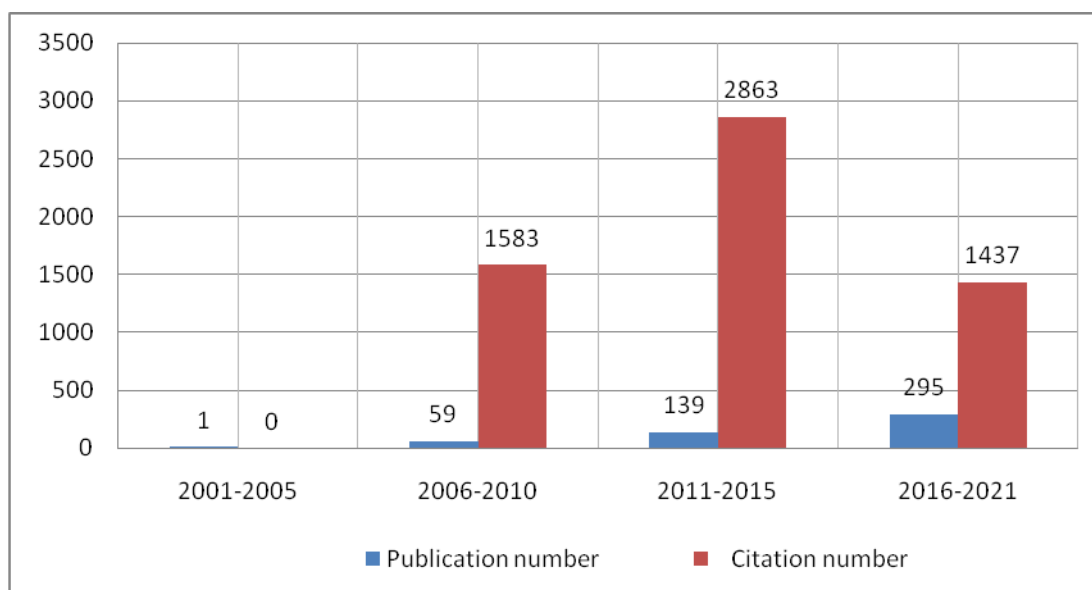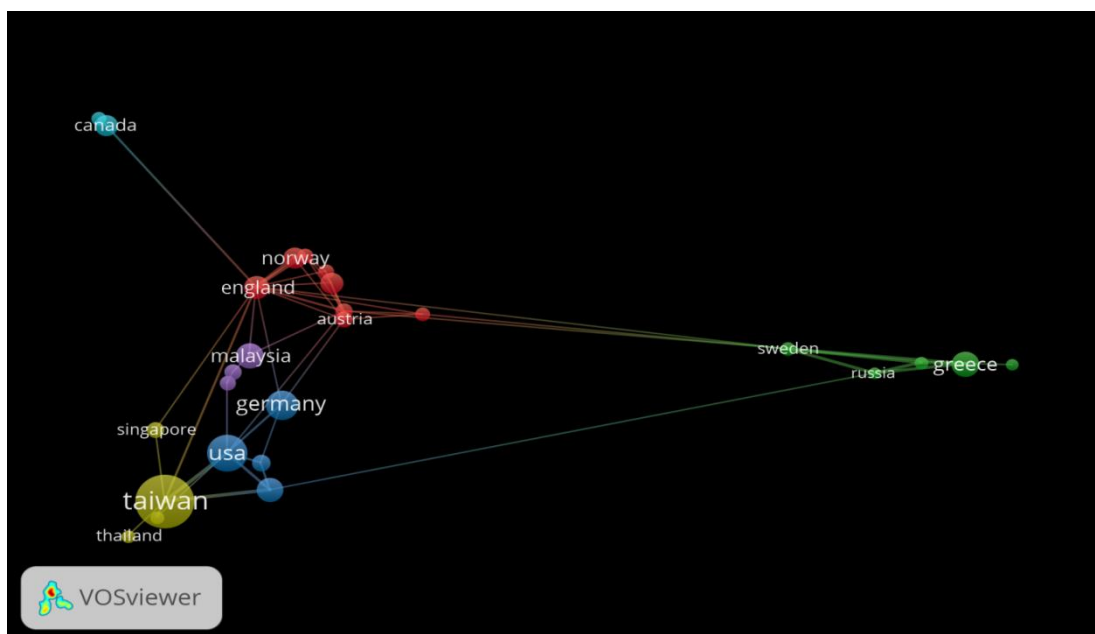

Source: Devised by the authors

According to Figure 1, it has been determined that an average of 24 publications are produced per year and the annual number of publications has been increasing exponentially. While the number of citations displayed a very limited appearance in the early 2000s, it gained significant momentum in the following periods. It has been observed that DGBL studies have shown a rapid development trend in recent years in terms of the number of publications and citations.

Co-authoring country collaboration

Co-authoring is one of the most tangible and well-documented forms of scholarly collaboration (GLÄNZEL; SCHUBERT, 2004). These collaborations are based on the idea that each country brings different forces, creating knowledge and innovation, sharing data in areas where a country may have difficulty in acting alone. Within this context, the social scientific relations between countries/regions in the world were investigated in this study, collaborating countries in at least five publications in the field were identified and visualized. The colors are created by VOSviewer software. Countries with the same colors have developed cooperation networks among themselves. The width of the circle increases or decreases according to the number of publications of that country. In addition, country cooperation is extremely important for the development of scientific disciplines because

articles with international authorship tend to be more cited and more effective (SHUKLA, 2021). Accordingly, the country with the largest node density in the area is Taiwan, represented in the yellow cluster. It is possible to attribute this situation to the large number of collaborative research on the field in Taiwan. It has been observed that Taiwan has established a cooperation network with Singapore and Thailand, two other countries with high node density. The red set has the most items, and the UK has the highest node density. It includes 8 countries including Austria, Netherlands, Czechia and Turkey. These countries are mostly in Europe. The green set has 5 elements, including Greece, Russia and Sweden. The yellow cluster includes European countries, including Germany, Greece, Finland and Italy. The blue cluster includes major global countries where scientific enterprise is strong, such as the USA, China, and Germany. The purple cluster represents Malaysia, South Korea and Indonesia. The turquoise cluster is the smallest and its main countries are Canada and France. The country with the most extensive research cooperation in the world is Taiwan. Taiwan has 6 links with a total strength of 16 links. The main countries with which Taiwan cooperates in science are China and the USA. It has been figured out that geographical location is an important factor affecting cooperation on science. Overall, it has been observed that a country's scientific productivity also paves the way for the expansion of research cooperation. Accordingly, the co-author collaboration map in the field is given below (Figure 2).

Figure 2 - Co-Authoring Country Collaborations Network Map

Source: Devised by the authors

Active institutions

Scientific research and development process is not only related to researchers and their scientific production. This situation also calls for the existence of scientific institutions that reinforce researchers and provide suitable environments for their work. Scientific institutions are directly involved in developing their research fields (DONTHU; KUMAR; PATTNAIK, 2020). Therefore, understanding the research productivity of institutions and their activities in the field can provide information about the development of the literature at the institution level. Within this context, institutional contribution analysis, which is one of the bibliometric techniques used in research evaluation, has an important potential. This analysis identifies the main drivers of a research field at the institution level (YU; HE, 2020). Accordingly, the 10 institutions that set the stage for the development of the field and have the most publications in the field are shown below (Table 1).

**Table 1 -** Active Institutions in the Field

Institution	Publication number	Citation number	Country
National Taiwan University of Science and Technology	26	890	Taiwan
National Central University	21	336	Taiwan
National Taiwan Normal University	13	211	Taiwan
Ghent University	12	305	Belgium
National Taipei University of Education	12	230	Taiwan
National University of Tainan	11	313	Taiwan
National Chengkung Unıversity	10	466	Taiwan
Nanyang Technologıcal University	9	68	Singapore
National Institute of Education (NIE) Singapore	8	68	Singapore
Interuniversity Microelectronics Centre (IMEC)	8	195	Belgium

Source: Devised by the authors

When Table 1 is examined, it has been observed that Taiwan-labeled institutions are dominant in the area. National Taiwan University of Science and Technology is the institution that publishes the most on the subject (n = 26). National Central University (n = 21) and National Taiwan Normal University (n = 13) come next, respectively. In addition, it would not be wrong to say that the main institutions contributing to the development of the field are universities from the Far East, and research institutes that cooperate with industrial sectors dependent on science and technology are among the effective institutions. To figure out the average citations of these institutions, citation analysis was performed and the data were mapped. Node density represents the number of citations for each institution. Color depth indicates higher average citation. Accordingly, National Chengkung University (Avg. Citation=46.60) is the institution with the highest average number of citations. This institution

is followed by the National Taiwan University of Science and Technology (Avg. Citation=34.23) and the National University of Tainan (Av. Citation=28.45) (Figure 3).

Figure 3 - Average Citation Network at Institution Level
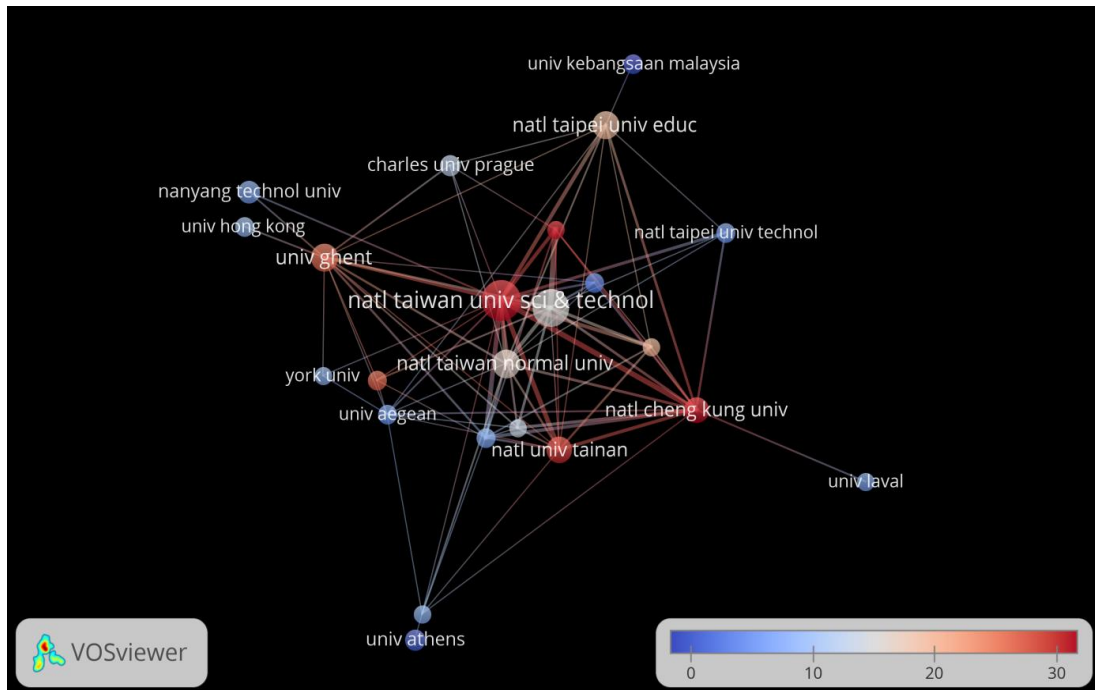
Source: Devised by the authors

Keyword network analysis

Keyword co-occurrence analysis can be used to uncover research topics and trends and is based on the number of coexistences of two words in the same publication, abstracts, or keywords. Within this respect, author keywords are very important to understand a discipline (ZUPIC; ČATER, 2015), it is believed that the authors reflect their personal visions of their subjects through keywords (KEVORK; VRECHOPOULOS, 2009). Accordingly, co-occurrence analysis was conducted to reveal research areas and current issues in the field.

The minimum number of repetitions for author keywords on the subject is set to 20. Spelling errors were combined by applying the exclusion process for concepts that did not match the analysis objectives, such as different keyword variants (for example, "DGBL" vs. "digital game-based learning"), and the relationships between keywords were clearly identified. As a result, the threshold for 1209 author keywords in the analysis 19 keywords have been mapped, the top ten author keywords are listed below (Table 2).

Table 2 - Most Frequently Used Keywords

Rank	Keyword	Co-occurrence	Cluster
1	digital game-based learning	195	4
2	game based learning	67	1
3	serious games	48	2
4	digital games	26	3
5	game design	21	4
6	motivation	19	1
7	gamification	17	1
8	interactive learning enviroments	17	3
9	educational games	14	2
10	learning	13	2

Source: Devised by the authors

The keyword co-occurrence network is demonstrated in Figure 4. Accordingly, four key clusters were obtained by co-occurrence analysis. The size of the nodes reflects the number of occurrences, and the links between the two nodes represent coexistence in the same document. The width of the circle and the font size reveal the keyword's link count and strength. The largest cluster, shown in yellow, represents conceptual learning models related to DGBL, mobile learning, game design. This zone reveals the relationship between DGBL and current education models. The second red cluster represents e-learning and game-based learning, gamification and motivation. It has been observed that the third cluster, the green cluster, is focused on serious games and this has an effect on the learning of educational games in mathematics education. It has been observed that the fourth cluster, the blue cluster, focuses on the relationship between the interactive learning environments of digital games and the learning/teaching strategy.

Figure 4 - Keyword Co-occurrence Network Map
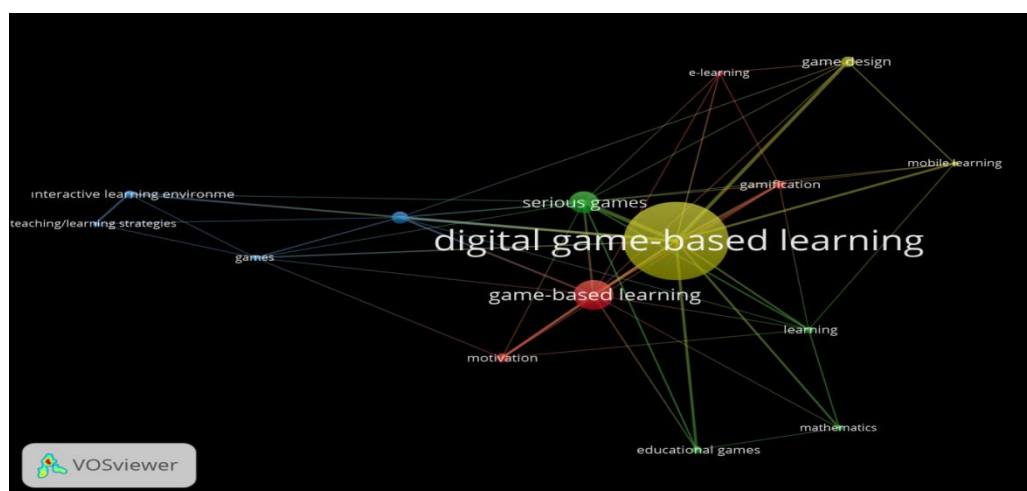
Source: Devised by the authors

Co-author citation network analysis

In this section, an author co-citation map was created in VOSviewer to map the authors who shaped the intellectual structure of the field and their production. The co-citation map focuses on the size and proximity of author nodes. Larger nodes indicate higher author citation frequency in reference lists of documents in the database under review. Closely grouped authors tend to share a stronger intellectual affinity in the content of their published works (WHITE; MCCAIN, 1998). Accordingly, the author presents key research themes encompassing co-citation analysis, a powerful approach to visualizing 'intellectual construct' or a body of knowledge. Within this aspect, it establishes relationships between frequently mentioned authors in a field of study and makes it possible to classify prominent research topics thematically (HALLINGER; WANG, 2020; KARAGÖZ; ŞEREF, 2021). Co-citation analysis reveals researchers, sources and articles that greatly influence the authors included in the review databases. Thus, insights into the knowledge organization of a particular field can be obtained in co-citation analysis (SHIAU; DWIVEDI; YANG, 2017). Within this context, it has been figured out that DGBL studies have an author co-citation network consisting of 35,671 authors. The author co-citation data was then digitized using VOSviewer and mapped in a co-citation network. Thus, the authors and sources that contributed to the development of scientific knowledge in the field are detailed (Table 3; Figure 5). Marc Prensky (828 co-citations) ranked first among the 10 most cited authors, followed by James Paul Gee (663 co-citations), Kristian Kiili (366 co-citations), Kurt D. Squire (343 co-citations), and Gwo-Jen. Hwang (341 joint citations).

Table 3 - Most Co-Cited Authors in the Field

Rank	Author	Country	Profession	Citations	Total link strength
1	Marc Prensky	The USA	Author and Speaker	287	2406
2	James Paul Gee	The USA	Linguist	194	1747
	Gwo-Jen Hwang	Taiwan	Education Technology	171	2217
3	Kristian Kiili	Finland	Education Technology	100	1141
4	Marina Papastergiou	Greece	Computer Engineering and Informatics	94	1192
5	Richard E. Mayer	The USA	Educational Psychologist	93	1317

Source: Devised by the authors

Figure 5 shows the researchers who influenced the knowledge structure of the field by co-author citation analysis. With the help of this analysis, it may be possible to identify the "invisible colleges" in the field. Crane (1972) defines the concept as groups of researchers working in a similar field and maintaining informal cognitive contacts with each other. Accordingly, it has been observed that there are intellectual structures that exchange information and create a research network through scientific knowledge in academic fields. When the DGBL publications indexed in WoS are examined, the most influential author in the first cluster (red) is Jie Chi Yang. In this cluster, the subject of game design for teaching environments supported by new technologies is predominant. In the second cluster (green) the focus is researcher Marc Prensky. The cluster is about digital game-based learning and it is related to the student, program and system level. In this cluster, the existence of authors who cognitively support the research infrastructure is evident (Bandura, Vygotsky, etc.). In the third cluster (blue), Gwo-Jen Hwang is the most influential researcher. Gwo-Jen Hwang stands out as a highly influential and visible researcher of the field. Educational technology and e-learning are thought to be at the forefront in this cluster. In the fourth cluster (yellow), John M. Keller is the most influential name. It has been observed that the cluster includes the authors related to cognition and learning theories, problem solving and educational multimedia design. In the fifth cluster (purple), Kurt D. Squire is in an effective position. The focus of the cluster is the creation of information and game systems based on artificial intelligence and machine learning for learners.

Their central positions on the map indicate that Marc Prensky, Gwo-Jen Hwang, and John M. Keller are the focus researchers in the literature. Princeky has gained an exceptional place in the field with the intellectual expansion he brought. It has been recognized that the author is the producer of the terms "Digital native" and "Digital immigrant", which are reference sources in the field. These concepts show their effects in the field in a continuous and diverse way (scientific, philosophical, sociological, etc.). Prensky 's high frequency of citations and link strength make him the core researcher of the field. The visualization for this is below (Figure 5).

Figure 5 - Author Co-Citation Network Visualization
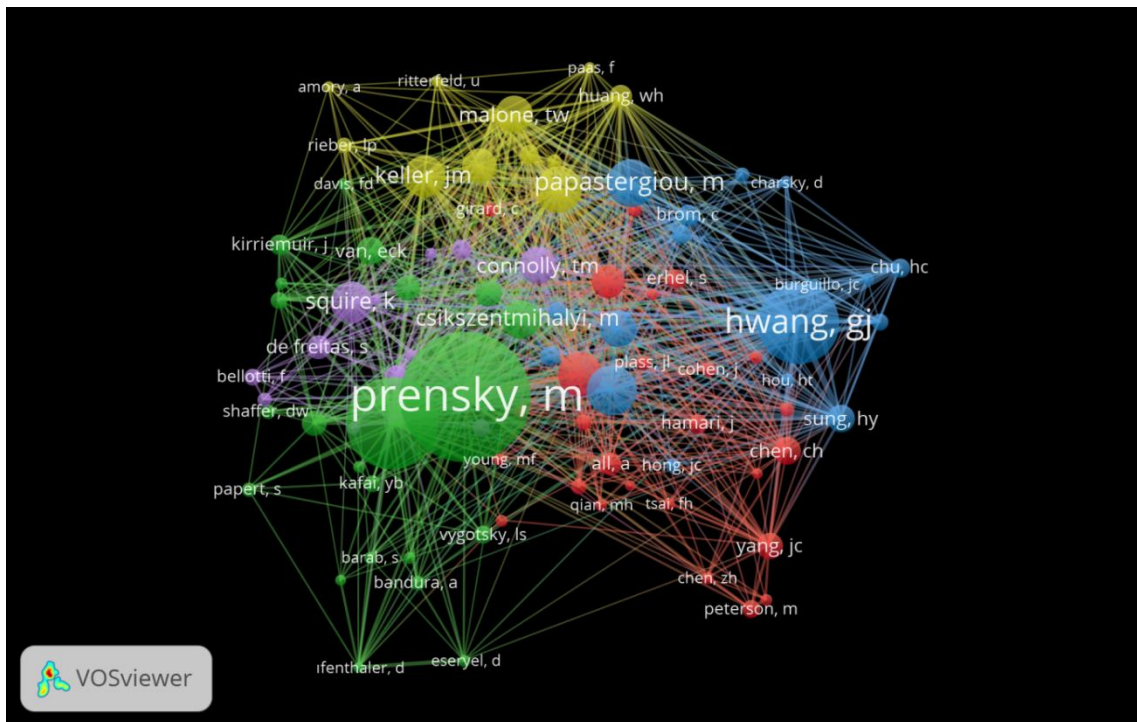
Source: Devised by the authors

Discussion and Conclusion

Bibliometric studies propose an innovative and functional approach to the design, conduct or analysis of scientific research. Within this respect, it is thought that it will bring a different perspective to educational research. This study aims to visualize and present the global scientific production of DGBL-based research between 2001-2021. Within this context, some remarkable results were obtained. Accordingly, there has been a rapid increase in the number of publications from the beginning to 2019. Publication production has manifested a relative decrease in 2020 and the following phase. On the other hand, considering that most of the publications were produced in 2015 and later, it has been figured out that there is still the potential to produce publications and get citations in the study area. Within this context, it can be said that research on DGBL is a current and popular subject of study. Another reason for this may be the diversification of learning environments with the developments in mobile technology nowadays. Thanks to the use of mobile technology, students no longer have to stay in the classroom to enhance their learning, in fact, they can adapt themselves to an interactive learning environment through the combination of technology and learning tasks (CHEN *et al.*, 2021; HWANG; CHEN, 2021). Within this

context, as technological developments progress, it is thought that the subject of DGBL will be on the agenda of educational research for a long time.

In the study, institutions with a high level of contribution to the research field were taken into account. Accordingly, National Taiwan University of Science and Technology, National Central University and National Taiwan Normal University are the academic institutions that contribute a lotto the field. These institutions play a crucial role in the design and development of the DGBL. In addition, the dominance of universities from Taiwan and Singapore in the literature draws attention and it has been figured out that scientific cooperation in these countries increases the power of scientific initiative. This illustrates that special attention has been given to the research area in the mentioned countries. However, it has been observed that the intellectual influence of Belgium has increased in the field as well. The studies of Martí-Parreño, Méndez-Ibáñez; Alonso-Arroyo (2016) support this finding.

Keyword analysis provides clues about the structure and content of scientific research because writers choose the words they care about as keywords. Within this respect, keyword analysis can enable the holistic monitoring of the scientific knowledge production process in the field, and the determination of trends and new perspectives. Therefore, it should be emphasized that it is a significant type of analysis in terms of academic disciplines. It is possible to see that the concepts of "digital game based learning" (DGBL), "game-based learning" and "serious games" come to the fore in the analysis. Within this context, it has been figured out that in the literature that the intellectual aspect of DGBL is shaped by the game-based learning approach and the game (ABT, 1987), which emerged for a different purpose (education, science, health etc.) other than entertainment are called serious games. Serious games are educational and learner-centered applications developed for an important purpose by combining gaming and learning technologies. These apps use the features of video games to engage the individual in a learning experience. These are computer-assisted learning environments that combine simulation, emotional responses and professionalization (ZYDA, 2005). These technologies are economical, time-saving and provide feedback in a short time, have a dynamic structure that attracts students to participate in games, encourage the development of purpose-oriented skills beyond instant entertainment, and strengthen cooperation and motivation (ECALLE; MAGNAN, 2013) are an effective tool for educational environments to achieve their goals. These demonstrate that the subject has a strong research potential in terms of academic studies and can be a focus for further studies. Therefore, it may be helpful for researchers to conduct research involving "serious games", which is a key issue in their future work.

Among the 1134 authors listed in the dataset, it was observed that there were certain authors who had been publishing on the DGBL for a long time. Professor Gwo-Jen Hwang of the Taiwan National University of Science and Technology remains the most active researcher over the 20-year period. The researcher has produced influential publications examining the role of different learning strategies integrated with DGBL on students' academic achievement, learning motivation and self-efficacy. These publications have contributed to the abandonment of the traditional negative understanding of DGBL (SUNG; HWANG; YEN, 2015). However, it has been observed that researchers from European Union member countries dominate the list of authors in DGBL studies.

Co-author citation analysis makes it possible to identify researchers with high intellectual contribution in the development of scientific fields. Scientists contributing to the development of the field with their long-standing academic effects are called "core researchers". This term defines researchers who maintain their intellectual influence in the field with the number of publications and citations (BRITTAIN, 2000). According to co-author citation analysis, Marc Prensky, Gwo-Jen Hwang, James Paul Gee, Kristian Kiili, and Kurt D. Squire were identified as core researchers of the DGBL literature. Within this context, focusing on the identified authors and their documents may enable field researchers to explore the knowledge and research memory of the field.

Although this study makes various contributions to the literature, it should be noted that it includes some limitations. In the research, bibliometric and social analysis data were obtained from the WoS database. Publications in databases such as Scopus, ERIC, Microsoft Academic are not included in the study. The data of these databases can create differences in the number of documents or citations, and this may cause different results.

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How to reference this article

Processing and editing: Editora Ibero-Americana de Educação.
Correction, formatting, normalization and translation.