A Bibliometric Analysis of Studies on Educational Games

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ABSTRACT

In this study, it was aimed to examine a total of 254 articles about educational games in the WoS database between 2012-2021 in terms of bibliometric indicators. For this purpose, the keywords used in the articles, the cited studies, the density of co-citations according to the time course, the distribution of cited journals, the country and affiliation co-operations were analyzed by social network analysis. It is determined that the largest keyword set is "educational computer game". When the most cited studies are examined, it is seen that these studies focus on topics such as computer and digital games, game-based learning. While studies on performance-based game-based learning were mostly cited in 2012, it has been noted that the most cited subjects in recent years are studies on digital, mobile and computer-based games. It has been seen that the most cited journal in scientific studies on educational games is "Computer & Education". It has been determined that the most important place in the cooperation between countries belongs to the USA, Spain and Taiwan, respectively. In terms of corporate collaborations, it has been seen that the "National Taiwan University of Science and Technology" in Taiwan is in an important and critical position that allows other institutions to stay in contact.

Anahtar Kelimeler: Bibliometric analysis, digital games, educational games, social network analysis.

Eğitsel Oyunlar ile ilgili Yapılan Çalışmaların Bibliyometrik Bir Analizi

ÖZ

Bu çalışmada 2012-2021 yılları arasında WoS veri tabanında yer alan eğitsel oyunlar ile ilgili toplam 254 makale bibliyometrik göstergeler açısından incelenmesi amaçlanmıştır. Bu amaçla, makalelerde kullanılan anahtar kelimeler, atıf yapılan çalışmalar, ortak atıfların zaman akışına göre yoğunluğu, atıf yapılan dergilerin dağılımı, ülke ve kurum işbirlikleri sosyal ağ analizi ile çözümlenmiştir. En büyük anahtar kelime kümesinin "educational computer game" olduğu belirlenmiştir. En çok atıf alan çalışmalar incelendiğinde ise bu çalışmaların bilgisayar ve dijital oyunlar, oyun tabanlı öğrenme gibi konular üzerine odaklandığı görülmüştür. 2012 yılında daha çok performansa dayalı oyun tabanlı öğrenme ile ilgili çalışmalar atıf almışken son yıllarda en çok atıf alan konular dijital, mobil ve bilgisayar tabanlı oyunlar üzerine olan çalışmalar olduğu dikkatleri çekmiştir. Eğitsel oyunlar ile ilgili yapılan bilimsel çalışmalarda en çok atıf alan derginin "Computer & Education" olduğu görülmüştür. Ülkeler arası iş birlikteliğinde en önemli yerin sırasıyla Amerika Birleşik Devletleri'ne İspanya'ya ve Taiwan'a ait olduğu belirlenmiştir. Kurum iş birliktelikleri açısından ise Tayvan'da yer alan "National Taiwan University of Science and Technology" 'nın diğer kurumların ilişki içinde kalmasını sağlayan önemli ve kritik bir konumda olduğu görülmüştür.

Keywords: Bibliyometrik analiz, dijital oyunlar, eğitsel oyunlar, sosyal ağ analizi.

Introduction

Games are a sociocultural structure that has existed since the birth of human history and contributes to the social, emotional, cognitive, physical and linguistic development of children (Kuzu, 2022). According to Kukul (2013), game is an enjoyable activity that supports the development of the child and with an important role in getting ready for life. It is an activity that develops the child's interest and curiosity, activates his mental skills, increases his creativity and contributes to putting what he has learned into practice (Güneş, 2015). In other words, game is teaching the subject and concept that no one else can teach the child by himself, thanks to his own life and experiences (Kuğuoğlu and Kürtüncü-

Tanır, 2006). Game, which is an indispensable part of life, emerges as an effective tool in transferring knowledge and ensuring permanence (Duran and Tufan, 2017).

Games, which have an important place after the basic needs such as nutrition, shelter and protection from the past to the present, have emerged as an effective method and approach that is used in the education-teaching process as well as educational materials in recent years. Game, which is the most basic need of childhood, turns into an educational tool that can meet all kinds of needs of the child when it is presented in a well-planned and purposeful format (Baş, Kuzu and Gök, 2020). The concept of educational game comes to the fore in increasing the permanence of the information by ensuring that the learned information is repeated in a fun and comfortable environment. The different aspect of educational games, also referred to as Games for Learning [G4L], from ordinary games is that educational games are designed to give the player a knowledge or skill (Kuzu, 2022). As a matter of fact, the application of games with educational content can effectively stimulate children's interest in learning, improve children's practical thinking abilities, grasp independent participation and awareness of rules. Education-teaching process includes with from pre-school to graduate education (Kuzu, Kuzu and Gelbal, 2019) and it is indicated that educational games are an important and indispensable part of this process. They are a tool that allows to be taught practically in a more comfortable environment by planing in advance in line with the determined purposes, and to reinforce the learned information by repeating. Educational game is a teaching technique that ensures the repetition of the learned information in a comfortable and safe environment and increases the permanence (Demirel, 2010). It makes the participation of even children who have insufficient interest in the lesson and do not actively participate in the lesson (Demirel, 2015).

Educational games, which are rich and diverse, are widely used not only to develop children's cooperative spirit and thinking skills, however also to develop children's awareness of competition and rules. On the other hand, educational games also contain educational values and develop all the skills that children have (Zaman, 2014). For example, it has been stated in studies that educational games increase creative thinking (Adıgüzel, 1993; Kaptan and Korkmaz, 1999), problem solving (Şahhüseyinoğlu, 2007), decision making, analytical and critical thinking (Baş et al., 2020). As a matter of fact, it can be said that high-level thinking skills are directly or indirectly related to each other (Karnes and Bean, 2009), and so that a game that causes an increase in any skill will contribute to the development many skills (Baş et al., 2020). In addition, educational games provide children with some gains such as strategic thinking, planning and effective communication (Kirriemur and McFarlane, 2004). Thanks to educational games, course topics can become interesting, new concepts can be taught, and learned concepts can be reinforced (Kaya, 2007).

When the literature is examined, it is seen that the concepts such as educational games and serious games, game-based learning and gamification are still confused. However, it is very important to make this distinction. Gamification is defined as transforming non-game environments into game environments by designing game rules and game components in order to increase individuals' experiences, motivation and interest levels (Domínguez, Saenz-de-Navarrete, de-Marcos, Fernández-Sanz, Pagés and Martinez-HerráIz, 2013). Not used for gamification, gaming and gaming environments; It is a concept used for environments other than games such as health, sports, nutrition, marketing and education. For example, giving a star to students for each known question in a classroom setting, creating a leaderboard based on the stars they received, and giving various gifts to the top three can increase students' motivation and performance towards the lesson, it can prepare the ground for a more enjoyable course process, and students can be offered the opportunity to learn by doing without fear of making mistakes (Kuzu, 2022). However, in addition to its contribution to the learning environment, it is stated that gamification will increase the competition among students (Buckley and Doyle, 2016) and may negatively affect students' motivation in the long run (de-Marcos, Domínguez, Saenz-de-Navarrete and Pagés, 2014; Denny, 2013; Hanus and Fox, 2015). Unlike gamification, game-based learning is the use of the game itself as a tool in the learning process. While completely real environments are used in gamification, unreal environments are used in game-based learning (Meşe and Dursun, 2017). Thanks to the motivating feature of game-based learning, students can reach the desired gains in a more fun way and can participate in the lesson as if they are playing a game (Anastasiadis, Lampropoulos and Siakas,

2018). However, according to Ülküdür and Bacanak (2013), when the class size is large, the time to be allocated to game-based learning environments will be longer and this may lead to a waste of time. Serious games, on the other hand, are games played with a specific goal, whose main purpose is not entertainment. Serious games seek to provide skill development based on knowledge building. Serious games are games that can offer content very similar to real-world situations created by professional design teams. Walking on the lunar surface with VR (Virtual Realty) glasses or creating a repetitive and controlled scenario environment with a flight simulator without any risk to the environment can be given as examples of serious games. As you can see, the main purpose here is not entertainment, but education on a specific subject. Although serious games and educational games have similarities, they are not the same thing (Becker, 2017). Educational games are predominantly made for children and students of all ages and can be used both inside and outside the classroom. Educational games are games designed to teach people a certain subject or a certain skill and are a subset of serious games (Kuzu, 2022).

In recent years, the number of scientific studies in this field has increased and inspired researchers due to the fact that games are seen as structures that with the important roles in the development of individuals (Uğurel and Moralı, 2008). One of the sources where scientific studies meet with readers is scientific journals. Scientific journals contribute to the dissemination of research and scientific information conducted through scientific processes, to the environment, to the transfer from generation to generation, and to the development of science. With scientific journals, an area of communication and interaction emerges in the world of science (Bozdoğan, 2020). Publications in scientific journals; it is a clear indication of whether scientific methods are carried out correctly. The effectiveness of scientific publications in scientific circles is generally determined by bibliometric analysis (Bali, 2021). With the bibliometric analysis, the interests of the researchers and the research subjects are determined and allowed the evaluation of the publications in the relevant field (Zupic and Čater, 2015). The purpose of bibliometric analysis is to analyze certain features of documents or publications and to obtain data on the communication between scientists and scientific publications (Al and Çoştur, 2007). The number of authors, publication years, topics covered, journals in which they are published, and cited sources are analyzed quantitatively with bibliometric analysis (Al and Tonta, 2004). Bibliometric analysis is used that in the examination of the characteristics and trends of recorded information, in the analysis of the structures of scientific and research fields, in the evaluation of research activities and in the management of scientific information (Patra, Bhattacharya, and Verma, 2006). Bibliometric analysis is based on indicators (Abramo, Angelo and Caprasecca, 2009) and provides a powerful method and dataset to examine both the structure and process of scientific communication (Borgman and Furner, 2002). From multiple databases (e.g., Cambridge Scientific Abstracs Illumina, Directory of Open Access Journals [DOAJ], Embase, Google Scholar, Medline, Open Archives Initiative [OAI], ProQuest, PsycINFO, Registry of Open Access Repositories [ROAR], Scopus, Sociological Abstracts and Compendex, TR Index, Web of Science [WoS]) to perform bibliometric analysis) and data tools (e.g., BibExcel, CiteSpace, CitNetExplorer, Science of Science (Sci2) Tool, SciMAT, VantagePoint, VOSviewer) can be used perform bibliometric analysis. In this study, research was conducted on the WoS database produced by Clarivate Analytics, as it is one of the most important scientific citation scanning and analytical information platforms in the world and provides a comprehensive data content for researchers from different disciplines (Li, Rollins and Yan, 2018). The WoS database also includes international indexes such as Science Citation Index Expanded (SCIE), Social Science Citation Index (SSCI), Art & Humanities Citation Index (AHCI), and Emerging Sources Citation Index (ESCI), which are considered respected citation indexes. In this context, in this study, it was aimed to examine scientific publications related to educational games in terms of bibliometric indicators, and answers were sought for the following research questions.

1) What is the distribution of keywords used in articles?
2) What is the distribution of the cited studies in the articles?
3) What is the citation density according to the time course of the studies that are co-citiation in the articles?
4) What is the distribution of the journals cited in the articles?
5) What are the country co-operations regarding the articles?
6) What are the affiliation co-operations regarding the articles?

Method

In this section, detailed information was presented reletad to research design, data collection and analysis. In which the quantitative research approach was adopted, the descriptive survey research design was used. Data were collected by document analysis technique.

Data Collection and Analysis

During the data collection process, first of all, the expressions "educational games" and "educational game" were written separately for each of the "title", "abtract" and "keywords" fields in the "Web of Science™ Core Collection" section of the WoS database. In the "Refine results" field, the expression "mathematics or mathematic or maths or math" was entered. Then, in the "Publication Years" tab such "2012-2021"; in the "Document Types" tab such "Article"; in the "Web of Science Categories" tab such "Education Educational Research"; in the "Web of Science Index" tab such as Science Citation Index Expanded® (SCIE), Social Sciences Citation Index® (SSCI) and Emerging Sources Citation Index® (ESCI) restrictions were applied. As a result of the scans, a total of 254 articles on educational games in the WoS database between the years 2012-2021 were obtained. The obtained articles were analyzed with the social network analysis method in line with the parameters of the evaluative bibliometric method. Bibliometrics is a quantitative method that enables the bibliographic information of publications to be analyzed using statistical methods (Holden, Rosenberg and Barker, 2005). Evaluative bibliometry, on the other hand, is an analysis method for scientific activities that focuses on the quality of scientific performance (Narin, 1976). In this study, the articles about educational games were examined and the keywords used in these articles, the cited studies, the density of co-citations according to the time course, the distribution of cited journals, country and affiliation co-operations were analyzed using bibliometric analysis techniques. Within the scope of the study, the social network analysis method was used while performing the bibliometric analysis. Social network analysis, on the other hand, is a quantitative method used to determine the characteristics of social actors and to define and visualize the relationship structures between actors (Wasserman and Faust, 1994). The software called CiteSpace, which uses both bibliometric and social network analysis methods together, was used in the analysis process. CiteSpace is a Java-based program used for the analysis and visualization of co-citation networks (Chen, 2004).

Research Ethics

This study is an international comparative education study in terms of its subject, and there is a human or animal subject within the scope of the research; data collection methods such as experiments, observations, questionnaires or interviews were not used. For this reason, it was not necessary to obtain an ethics committee report.

Findings

In this section, scientific publications related to educational games were examinedin line with the research questions in terms of bibliometric indicators and the findings obtained were presented in detail.

Findings on the Distribution of Keywords Used in Articles

The most frequently used keywords in scientific studies on educational games were analyzed by social network analysis. The network map of the clusters formed by the keywords is presented in Figure 1.

Figure 1. Network Map of Clusters Formed by Keywords

According to Figure 1, the modularity q index of the network is .31, and the weighted mean silhoutte index is .66. When these two indices are close to 1.00, it means that the clustering is good (Chen, 2014). In this study, it is seen that the keywords used in scientific studies on educational games are divided into eight clusters and the first and largest cluster defined in the network is "educational computer game". While "intelligent social tutoring system" is in the second place, this cluster is followed by the "automatic method" cluster in the third place. The smallest cluster in the network analysis is the "game design" cluster, which is in the last place. Statistics related to clusters are presented in Table 1 in detail.

Table 1
Statistics and Keywords on Clusters

Cluster ID	Size	Silhoutte	Year	Top terms (log-likelihood ratio, p-level)
educational computer game	64	.679	2013	educational computer game (553.85, 1.0E-4); emotional intelligence (338.62, 1.0E-4); cognitive performance (338.62, 1.0E-4); video game (203.06, 1.0E-4); natural science courses (196.48, 1.0E-4)
intelligent social tutoring system	55	.581	2015	intelligent social tutoring system (199.25, 1.0E-4); year-old children (195, 1.0E-4); home literacy environment (195, 1.0E-4); literate cultural capital (195, 1.0E-4); storybook reading (195, 1.0E-4)
automatic method	52	.649	2016	automatic method (177.58, 1.0E-4); e-learner emotion (177.58, 1.0E-4); using behavioral cue (177.58, 1.0E-4); behavioral intention (176.15, 1.0E-4); using escribo play video game (173.56, 1.0E-4)
augmented reality	47	.651	2015	augmented reality (245.35, 1.0E-4); social network (199.08, 1.0E-4); role-playing game (145.19, 1.0E-4); prior knowledge (145.19, 1.0E-4); training arithmetic (142.63, 1.0E-4)
learning performance	44	.589	2015	learning performance (186.25, 1.0E-4); information literacy (182.17, 1.0E-4); secondary school (159.74, 1.0E-4); educational computer game (120.79, 1.0E-4); teacher education (113.33, 1.0E-4)
educational video game	28	.724	2016	educational video game (281.98, 1.0E-4); wildfire response (165.71, 1.0E-4);

				learning game (164.94, 1.0E-4); mobile device (160.97, 1.0E-4); learning history (160.97, 1.0E-4)
logical ability	22	.812	2016	logical ability (153.65, 1.0E-4); usage intention (147.65, 1.0E-4); alternate reality board game (145.76, 1.0E-4); using flow-based model (141.68, 1.0E-4); affecting student (139.92, 1.0E-4)
game design	8	.898	2015	game design (120.34, 1.0E-4); digital platform (109.59, 1.0E-4); problem-solving approaches (103, 1.0E-4); general problem-solving style (98.89, 1.0E-4); distance education (88.24, 1.0E-4)

In Table 1, the clusters consisting of the keywords used in the studies and the statistics of the clusters are given. Accordingly, it is seen that the largest cluster is the "educational computer game" cluster, which includes 64 studies and studies on educational computer and video games. The avarage publication year of the publications cited in the studies included in this cluster is 2013. When the clusters are examined from this point of view, it can be said that the newest subjects are gathered in the "automatic method", "educational video game" and "logical ability" clusters. Silhoutte value, which gives information about whether the structure of the cluster is homogeneous or not (Chen, 2006); it is described as "excellent" in the range of .71-1.00, "acceptable" in the range of .51-.70, "poor" in the range of .26-.50, and "poor" in the range of .25 and below (Mamat et al., 2018). A Silhoutte value higher than .70 means that the relationship of the keywords in the cluster is quite close (Rousseeuw, 1987). In this context, when the Silhoutte indexes of the clusters are examined in Table 1, the "educational video game", "logical ability" and "game design" clusters have excellent homogeneity, while the other clusters have acceptable homogeneity.

Findings on the distribution of the Studies Cited in the Articles

The most co-citation publications in the studies examined within the scope of this study were examined by social network analysis and the network map is presented in Figure 2.
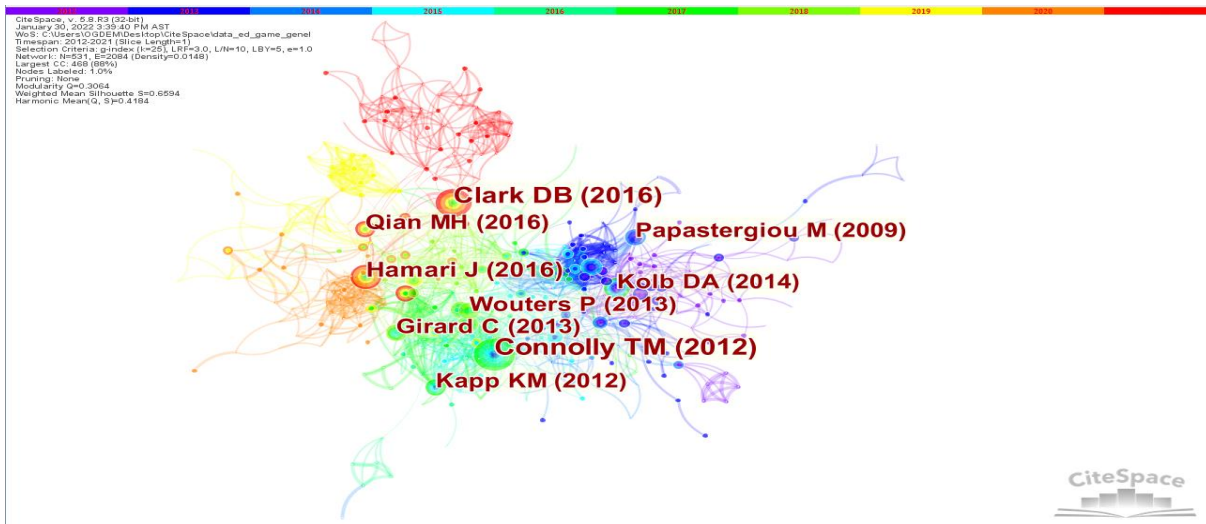

Figure 2. Co-citation Analysis Network Map

In Figure 2, the network map of co-citations in scientific studies on educational games consists of 531 nodes and 2084 links. Each resulting node represents a study. While the size of each node is in the citation ratio of the publication, the thickness of the rings indicates the number of citations corresponding to the specified time period by coloring them in accordance with the timeline on the figure (Chen and Kuljis, 2009). The links given between the nodes and showing the citation relations

together are also colored in accordance with the timeline. Accordingly, it is seen that the most effective study in the network belongs to Connolly, Boyle, MacArthur, Hainey and Boyle (2012). Clark, Tanner-Smith and Killingsworth (2016) is the second important study in the network.

Findings on Citation Density according to Time Course of the Studies that are Co-Citation in Articles

In the articles examined within the scope of this study, the citation density was examined according to the time course of the studies that were co-citation, and the network map is presented in Figure 3.
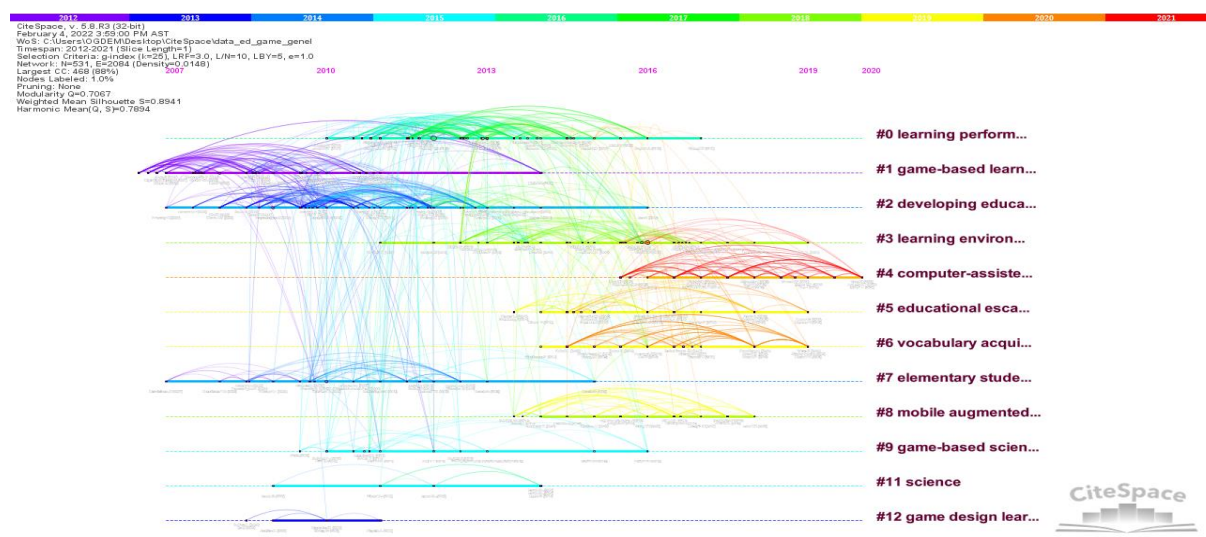

Figure 3. Citation Density Map by Time Course

In Figure 3, the clustering of the studies that are co-citation in educational game studies conducted between 2012-2021 according to time is seen. Accordingly, it can be said that the cited studies were examined in 12 clusters. The colors in the network map are matched to the colors of the timeline at the top of the figure. Detailed information about the five most cited studies is presented in

Table 2
Most Cited Studies According to Co-Citation Analysis

Frequence	Reference
42	Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T. and Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & education*, *59*(2), 661–686.
34	Clark, D. B., Tanner-Smith, E. E. and Killingsworth, S. S. (2016). Digital games, design, and learning: A systematic review and meta-analysis. *Review of educational research*, *86*(1), 79–122.
27	Hamari, J., Shernoff, D. J., Rowe, E., Coller, B., Asbell-Clarke, J. and Edwards, T. (2016). Challenging games help students learn: An empirical study on engagement, flow and immersion in game-based learning. *Computers in human behavior*, *54*, 170–179.
24	Papastergiou, M. (2009). Digital game-based learning in high school computer science education: Impact on educational effectiveness and student motivation. *Computers & education*, *52*(1), 1–12.
24	Kolb, A. Y., Kolb, D. A., Passarelli, A. and Sharma, G. (2014). On becoming an experiential educator: The educator role profile. *Simulation & Gaming*, *45*(2), 204–234.

According to Table 2, while studies on performance-based game-based learning were mostly cited in 2012, the most cited topics in recent years are studies on digital, mobile and computer-based games. The 10 studies with the highest citation burst values according to the social network analysis are presented in Figure 3.

References	Year	Strength	Begin	End	2012 - 2021
Papastergiou M, 2009, COMPUT EDUC, V52, P1, DOI 10.1016/j.compedu.2008.06.004, DOI	2009	8.85	**2012**	2014	
Ke FF, 2008, COMPUT EDUC, V51, P1609, DOI 10.1016/j.compedu.2008.03.003, DOI	2008	6.23	**2012**	2013	
Annetta LA, 2009, COMPUT EDUC, V53, P74, DOI 10.1016/j.compedu.2008.12.020, DOI	2009	5.86	**2012**	2014	
Connolly TM, 2012, COMPUT EDUC, V59, P661, DOI 10.1016/j.compedu.2012.03.004, DOI	2012	9.94	**2014**	2017	
Kapp KM, 2012, GAMIFICATION LEARNIN, V0, P0	2012	6.98	**2014**	2017	
Young MF, 2012, REV EDUC RES, V82, P61, DOI 10.3102/0034654312436980, DOI	2012	6.02	**2014**	2017	
Girard C, 2013, J COMPUT ASSIST LEAR, V29, P207, DOI 10.1111/j.1365-2729.2012.00489.x, DOI	2013	6.1	**2015**	2018	
Wouters P, 2013, J EDUC PSYCHOL, V105, P249, DOI 10.1037/a0031311, DOI	2013	8.57	**2016**	2018	
Clark DB, 2016, REV EDUC RES, V86, P79, DOI 10.3102/0034654315582065, DOI	2016	9.23	**2018**	2021	
Qian MH, 2016, COMPUT HUM BEHAV, V63, P50, DOI 10.1016/j.chb.2016.05.023, DOI	2016	7.29	**2018**	2021	

Figure 3. Explosion Values of the 10 Studies with the Highest Explosion Values by Years

When the studies with the most citation explosion are examined; Papastergiou (2009), Ke (2008) and Annetta, Mangrum, Holmes, Collazo and Cheng (2009) are the most used references between 2012 and 2014. On the other hand, in recent years, Clark et al. (2016) and Qian and Clark (2016) are the most used. The explosion value is between 9.94 and 2014-2017 and belongs to Connolly et al. (2012).

Findings on the Distribution of Journals Cited in Articles

Social network analysis of the journals cited in scientific studies on educational games was made and the network map is presented in Figure 4.
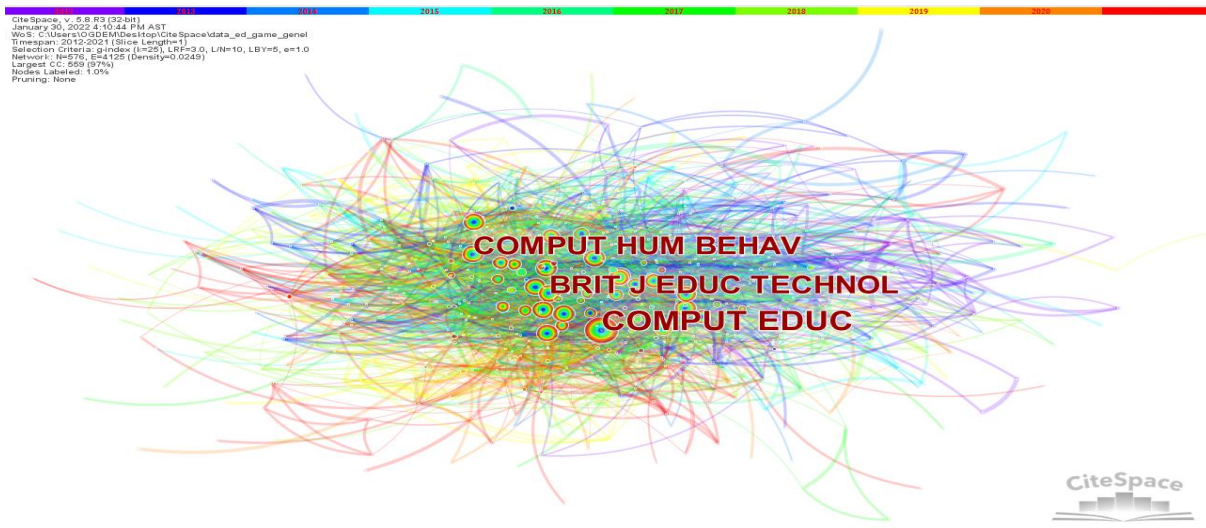

Figure 4. Network Map of Cited Journals

According to Figure 4, "Computer & Education" is the first in the list of the most cited journals in the studies examined (f= 565). The other journal that has the most important place in the network map is "British Journal of Educational Technology" (f= 316), which is in the second place.

Findings on the Country Co-Operations regarding the articles

In order to determine the country co-operation regarding the scientific studies examined within the scope of this study, it was examined by social network analysis and the network map is presented in Figure 5.

Figure 5. Network Map of Country Co-operation

In the network map obtained from the social network analysis, 91 nodes (countries) and 171 connections were obtained. The modularity index of the network was calculated as .97, and the mean Silhoutte index was calculated as 1.00. Therefore, it can be said that the network has a homogeneous and loose structure, in other words, it is sufficiently clustered. According to the network map, the most important position in cooperation between countries belongs to the USA (f=265). Spain (f=123) takes the second place, followed by Taiwan (f=96) in the third place.

Findings on the Affiliation Co-Operations regarding the Articles

In order to determine the pattern of co-operation of affiliations where studies on educational games are carried out, a social network analysis was made and the network map is presented in Figure 6.
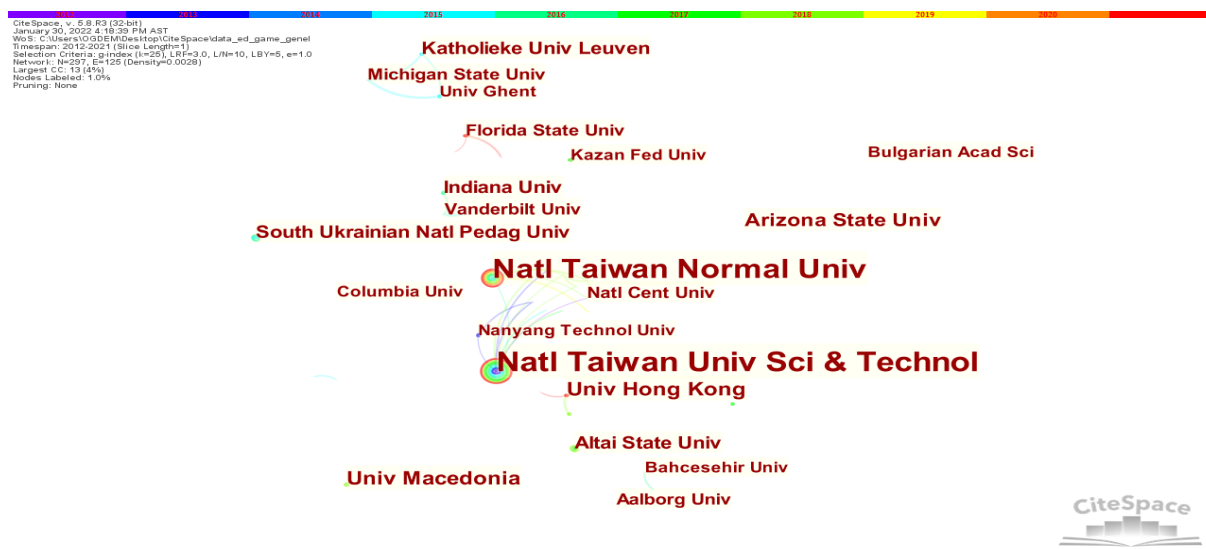

Figure 6. Network Map of Affiliation Co-operations

According to the social network analysis, the network consists of 297 nodes and 125 connections. In affiliation co-operation in the network, it can be said that "National Taiwan University of Science and Technology" (f=29) is in an important and critical position which ensures that other institutions remain in contact and that the communication of the institution. The second most important affiliation in the affiliation co-operation studying network is the "National Taiwan Normal University" (f=27). These affiliations act as a bridge between institutions by keeping the bond between clusters alive.

Conclusion and Discussion

In this study, it was aimed to examine a total of 254 articles about educational games in the WoS database between 2012-2021 in terms of bibliometric indicators. For this purpose, the keywords used in the articles, the cited studies, the density of co-citations according to the time course, the distribution of cited journals, the country and affiliation co-operations were analyzed by social network analysis.

It is observed that the keywords used in scientific studies on educational games are divided into eight clusters and the first and largest cluster defined in the network is "educational computer game". In recent years, the tendency to games with digital content has increased, because of development of technology; increase in rapid urbanization, crime rates, malicious people, child abuse; decrease in the empty spaces used for gaming and the feeling of trust. The education system, which aims to raise qualified individuals and to have an effective education process (Caliskan, Kuzu and Kuzu, 2017), tries to turn these games with digital content, which replace traditional games, into an advantage. Because, if the boundaries are set correctly, a more permanent and effective learning environment will be created by integrating technology with games and integrating it into the education system (Kuzu and Sıvacı, 2018). In addition, with digital games with educational content, expression will be facilitated and learning will be more enjoyable (Özüdoğru, 2021). In this context, the use of technology-supported games in the education process comes to the fore and it is explained why the studies are mostly on digital games with educational content.

In the scientific studies on educational games, it was seen that the most references were made to the studies made by Connoly et al. (2012) and Clark et al. (2016). When these studies are examined, it is seen that they are in the form of a literature review. In academic research conducted as a continuation of each other, it is important to review previous studies on the research subject. As a matter of fact, it is important to determine the point reached about the researched subject, to reveal the gaps and omissions in the literature, and to determine where the current study will fit within the previous literature (Demirci, 2014). In this context, it can be said why these two studies, which were conducted as literature studies, received the most citations.

When the most cited studies on educational games are examined, it is seen that these studies focus on subjects such as computer and digital games, and game-based learning. According to the social network analysis, it was determined that the studies with the most citation explosion between 2012 and 2014 were Papastergiou (2009), Ke (2008) and Annetta et al. (2009). In recent years, it is seen that the studies of Clark et al. (2016) and Qian and Clark (2016) are the most utilized sources. The highest citation explosion was observed in the study by Connolly et al. (2012) between 2014 and 2017. On the other hand, in studies on educational games conducted between 2012 and 2021, it is seen that the studies with common references are gathered in twelve clusters according to time. When the clusters are examined, it has been noted that while studies on performance-based game-based learning were mostly cited in 2012, the most cited subjects in recent years were studies on digital, mobile and computer-based games. The fact that the game is seen as a performance-based activity rather than a behavioral process (Aksoy, 2020) and that performance-based games take an important place among the game genres (Sutton-Smith, 1997) may be an indication of why many studies on performance-based games have been made in the past. In addition, while past games often took place in non-closed spaces such as parks and streets, face-to-face interactions and performance-based; nowadays, with the development of technology, it takes place in closed and virtual environments, with virtual friendships (Horzum, Ayas ve Çakır-Balta, 2008). This may cause performance-based games to leave their place to games with digital content, therefore in parallel, today's studies may have more focused on digital games.

It is seen that the most cited journal in scientific studies on educational games is "Computer & Education". It is seen that this journal is indexed in 28 international databases, mainly SCIE, SSCI, Education Resources Information Center (ERIC) as of 2020, its Impact factor is 8,538 and it ranks 3rd among 264 journals in the field of Education & Educational Research. The second journal with the most important place in the network map is the "British Journal of Educational Technology". As of 2020, it

is seen that this journal is indexed in important international databases such as SSCI and ERIC, its Impact factor is 4.929, and it is in the 19th place out of 265 journals in the field of Education & Educational Research. As it is known, the impact factor is a measure of an academic journal that reflects the average number of citations to the current articles published in that journal and is used as a relative indicator of the importance of the journal in its field. In this case, it can be said that both journals are in the category of qualified journals. On the other hand, when the purpose and scope of both journals are examined, it is seen that they are similar to each other and focus on studies on the place and importance of digital technology in education. These journals aim to publish theoretical perspectives, methodological developments, and high-quality empirical research on how digital technology paves the way for developments and improvements in education (British Journal of Educational Technology, 2022; Computers & Education, 2022). The fact that today's studies are mostly technology-based and these journals are among the journals with a focus on digital technology in terms of purpose and scope may be an indicator of why these two journals are the most cited journals in scientific studies on educational games.

When the scientific studies on educational games are examined, it is seen that the most important place in the country co-operations belongs to the USA. Spain is in the second place and Taiwan is in the third place. On the other hand, when the pattern of the affiliation co-operations where studies on educational games are carried out is examined, it can be said that "National Taiwan University of Science and Technology" is in an important and critical position, which ensures that other institutions stay in touch and that the communication of institutions in the network continues. The second most important institution in the partner institution working network was found as "National Taiwan Normal University". It is quite remarkable that both institutions are located in Taiwan. When we look at the most cited "Computer & Education" magazine about educational games, the distribution of the countries of the authors published in the last five years also supports this situation. In this journal, It is seen that the American authors ranked first with 242 authors; Taiwanese authors are in the second place with 150 authors and Spanish authors are in the third place with 65 authors (Computers & Education Authors, 2022).

Author's Contributions

This study was conducted in equal collaboration between the two authors.

Conflict of Interest

The authors declare that there are no conflicts of interest.

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Genişletilmiş Özet

Giriş

Oyunlar insanlık tarihinin doğuşundan itibaren var olan ve çocukların sosyal, duygusal, bilişsel, fiziksel ve dilsel gelişimlerine katkı sağlayan sosyokültürel bir yapıdır (Kuzu, 2022). Geçmişten günümüze beslenme, barınma ve korunma gibi temel ihtiyaçların ardından önemli bir yere sahip olan oyunlar son yıllarda, eğitim-öğretim materyalinin yanı sıra eğitim-öğretim sürecinde de kullanılan ve verimliliği tartışılmayan etkili bir yöntem ve yaklaşım olarak da karşımıza çıkmaktadır. Çocukluk döneminin en temel ihtiyacı olan oyun, iyi planlanmış ve amaca hizmet eder bir formatta sunulduğunda çocuğun her türlü gereksinimi karşılayacak nitelikte eğitsel bir araca dönüşmektedir (Baş, Kuzu ve Gök, 2020). Nitekim eğitsel içerikli oyunların uygulanması, çocukların öğrenmeye olan ilgisini etkili bir şekilde teşvik edebilir, çocukların pratik düşünme yeteneklerini geliştirebilir, bağımsız katılımı ve kuralların farkındalığını kavratabilir. Ayrıca eğitsel içerikli oyunlar karar verme, analitik ve eleştirel düşünme gibi üst düzey becerileri becerilerini arttırmak da (Baş vd., 2020) ve stratejik düşünme, planlama yapma ve etkili iletişim kurma gibi bazı kazanımlar da kazandırmaktadır (Kirriemur ve McFarlane, 2004). Son yıllarda, oyunların bireylerin gelişiminde önemli roller üstlenen yapılar olarak görülmesi (Uğurel ve Moralı, 2008) üzerine, bu alanda yapılan bilimsel çalışmaların sayısı artmış ve araştırmacılara ilham kaynağı olmuştur. Bilimsel çalışmaların okuyucu ile buluştuğu kaynaklardan biri ise bilimsel dergilerdir. Bilimsel dergilerde yer alan bilimsel yayınlar; bilimsel yöntemlerin doğru bir şekilde yürütülüp yürütülmediğinin açık bir belirtisidir. Bilimsel yayınların bilim çevrelerindeki etkinliği genellikle bibliyometrik analiz yapılarak tespit edilmektedir (Bali, 2021). Bibliyometrik analiz ile araştırmacıların ilgi alanları ve araştırma yapılan konular tespit edilmekte olup ilgili alanda yapılan yayınların değerlendirilmesine olanak tanınmaktadır (Zupic ve Čater, 2015). Bu çalışmada dünyanın en önemli bilimsel atıf tarama ve analitik bilgi platformlarından biri olması ve araştırmacılar için farklı disiplinlere ilişkin geniş kapsamlı bir veri içeriği sunması nedeniyle (Li, Rollins ve Yan, 2018) Clarivate Analytics tarafından üretilen WoS veri tabanı üzerinden araştırma yapılmıştır. Bu bağlamda, eğitsel oyunlar ile ilgili bilimsel yayınların bibliyometrik göstergeler açısından incelenmesi amaçlanmıştır.

Yöntem

Nicel araştırma yaklaşımının benimsendiği bu çalışmada betimsel tarama modeli kullanılmış olup doküman incelemesi tekniği ile veriler toplanmıştır. Verilerin toplanması sürecinde, öncelikle WoS veri tabanında yer alan "Web of Science™ Core Collection" bölümündeki "title", "abtract" ve "keywords" alanlarının her birine ayrı ayrı "educational games" ve "educational game" ifadeleri yazılmıştır. "Refine results" alanına ise "mathematics or mathematic or maths or math" ifadesi girilmiştir. Ardından "Publication Years" sekmesinde "2012-2021"; "Document Types" sekmesinde "Article"; "Web of Science Categories" sekmesinde "Education Educational Research"; "Web of Science Index" sekmesinde ise Science Citation Index Expanded® (SCIE), Social Sciences Citation Index® (SSCI) ve Emerging Sources Citation Index® (ESCI) şeklinde kısıtlamalara gidilmiştir. Taramalar sonucunda 2012-2021 yılları arasındaki WoS veri tabanında yer alan eğitsel oyunlar ile ilgili toplam 254 makale elde edilmiştir. Elde edilen makaleler kullanılan anahtar kelimeler, atıf yapılan çalışmalar, ortak atıfların zaman akışına göre yoğunluğu, atıf yapılan dergilerin dağılımı, ülke ve kurum işbirlikleri açısından sosyal ağ analizi ile çözümlenmiştir. Analiz sürecinde hem bibliyometri hem de sosyal ağ analizi yöntemlerini bir arada kullanan CiteSpace adlı yazılım kullanılmıştır.

Bulgular

Eğitsel oyunlar ile ilgili yapılan bilimsel çalışmalarda en sık kullanılan anahtar kelimelerin sekiz kümeye ayrıldığı belirlenmiştir. Ağda tanımlanan ilk ve en büyük kümenin 'educational computer game' olduğu görülmektedir. İkinci sırada 'intelligent social tutoring system' yer alırken bu kümeyi üçüncü sırada 'automatic method' kümesi takip etmektedir. Ağ analizinde yer alan en küçük küme ise son sırada bulunan 'game design' kümesi olmuştur. Eğitsel oyunlar ile ilgili incelenen bilimsel çalışmalarda ortak yapılan atıflara ait ağ haritası incelendiğinde ise ağdaki en etkili çalışmanın Connolly, Boyle, MacArthur, Hainey ve Boyle (2012)'ye ait olduğu görülmektedir. Clark, Tanner-Smith ve Killingsworth

(2016) tarafından yapılan çalışma ise ağdaki ikinci önemli çalışma olarak belirlenmiştir. 2012-2021 yılları arasında yapılan eğitsel oyun çalışmalarında ortak atıf yapılan çalışmaların zamana göre kümelenmeleri incelendiğinde atıf alan çalışmaların on iki kümeye ayrıldığı görülmüştür. 2012 yılında daha çok performansa dayalı oyun tabanlı öğrenme ile ilgili çalışmalar atıf almışken son yıllarda en çok atıf alan konular dijital, mobil ve bilgisayar tabanlı oyunlar üzerine olan çalışmalar olmuştur. En çok atıf alan çalışmalarda ise bilgisayar ve dijital oyunlar, oyun tabanlı öğrenme gibi konular üzerine odaklanıldığı görülmektedir. En çok atıf patlaması yapan çalışmalar incelendiğinde; 2012-2014 yılları arasında Papastergiou (2009), Ke (2008) ve Annetta vd. (2009) çalışmalarının; son yıllarda ise Clark vd. (2016) ile Qian ve Clark (2016) çalışmalarının olduğu görülmektedir. En yüksek atıf patlama değeri ise 9.94 ile 2014-2017 yılları arasında olup Connolly vd. (2012) tarafından yapılan çalışmaya aittir. En çok atıf yapılan dergiler listesinde ilk sırada "Computer & Education" dergisi yer almaktadır (f= 565). Ağ haritasındaki en önemli yere sahip diğer dergi ise ikinci sırada yer alan "British Journal of Educational Technology" (f=316) dir. Ülke iş birlikteliği açısından en önemli konumun ABD'ye (f=265) ait oluduğu görülmüştür. İkinci sırada İspanya (f=123) yer alırken onu üçüncü sırada Taiwan (f=96) takip etmektedir. Kurum iş birliktelikleri açısından ise "National Taiwan University of Science and Technology" (f=29) nin diğer kurumların ilişki içinde kalmasını sağlayan, ağdaki kurum iletişiminin devam etmesini sağlayan önemli ve kritik bir konumda olduğu söylenebilir. Ortak kurum çalışma ağında ikinci sırada en önemli diğer bir kurum ise "National Taiwan Normal University" (f=27) dir.

Sonuç ve Tartışma

Nitelikli bireyler yetiştirmeyi ve etkili bir eğitim sürecinin geçirilmesini hedefleyen eğitim sistemi (Caliskan, Kuzu ve Kuzu, 2017), geleneksel oyunların yerini alan dijital içerikli bu oyunları avantaja çevirmeye çalışmaktadır. Çünkü sınırları doğru konduğu takdirde teknolojinin oyunlarla bütünleşmesi ve eğitim sistemine entegre edilmesi ile daha kalıcı ve etkili bir öğrenme ortamı oluşacaktır (Kuzu and Sıvacı, 2018). Bu bağlamda eğitim öğretim sürecinde teknoloji destekli oyunların kullanımı ön plana çıkmakta ve yapılan çalışmaların neden daha çok eğitsel içerikli dijital oyunlar üzerine olduğu açıklanmaktadır. Öte yandan, 2012 yılında daha çok performansa dayalı oyun tabanlı öğrenme ile ilgili çalışmalar atıf almışken son yıllarda en çok atıf alan konular dijital, mobil ve bilgisayar tabanlı oyunlar üzerine olan çalışmalar olduğu dikkatleri çekmiştir. Oyunun davranışsal bir süreç yerine performansa dayalı bir etkinlik olarak görülmesi (Aksoy, 2020) ve oyun türleri içerisinde performansa dayalı oyunların önemli yer tutması (Sutton-Smith, 1997) geçmişte neden performansa dayalı oyunlar üzerine çok çalışmaların yapıldığının bir göstergesi olabilir. Ayrıca, geçmişteki oyunlar sıklıkla oyun parkı ve sokaklar gibi kapalı olmayan mekânlarda, yüz yüze etkileşimlerle ve performansa dayalı gerçekleşirken; günümüzde teknolojinin gelişimiyle artık kapalı ve sanal ortamlarda, sanal arkadaşlıklarla gerçekleşmektedir (Horzum, Ayas ve Çakır-Balta, 2008). Bu durum ise performansa dayalı oyunların günümüzde dijital içerikli oyunlara yerini bırakmasına ve paralelinde de günümüz çalışmalarının daha çok dijital oyunlara yönelik olmasına sebep olabilir.