Game-Based Language Learning in Technological Contexts: An Integrated Systematic Review and Bibliometric Analysis

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ABSTRACT

In the COVID-19 pandemic, delivering learning content to students via the use of technologies has become mainstream. Among various technology-supported learning modes, game-based language learning (GBLL) has been considered an effective approach to engaging learners in joyful and interactive contexts. This study aims to provide an overview of GBLL using bibliometric mapping analysis and coding analysis. This systematic review provides a scoping overview of empirical evidence on the use and impacts of games in language learning from 1989 to 2020. Based on a set of criteria retrieved from the Web of Science, 101 articles were analyzed. The coding analysis were three aspects to identify the research issues, performance issues, and interaction issues. Moreover, in a comprehensive review of the research on GBLL, insights are provided for educators and future research. The findings differing from those of previous reviews can serve as a reference for researchers on GBLL-related studies.

KEYWORDS

INTRODUCTION

With global internationalization, the number of people learning foreign languages is increasing (Alfadil, 2020), but it is challenging to implement digital game-based language learning, especially since the global COVID-19 outbreak. Learning a foreign language can help students acquire communication skills and enhance their competitiveness (Chen, 2018). Besides, language learning can also increase students' critical thinking (Wight, 2015). Studies have pointed out that game-based

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learning can effectively improve learners' language effectiveness, such as improving their vocabulary skills through game-based e-books (Smith et al., 2013), improving students' grammar skills through role-playing digital games (Rojas & Villafuerte, 2018), and using serious games to effectively improve their language writing skills (Niemelä et al., 2020). However, scholars have indicated that language learning, and in particular, learning a second or foreign language, is generally challenging for students (Cheng & Chen, 2019). Wu et al. (2014) further indicated that lacking learning contexts and motivation are two factors affecting learners' language learning outcomes. Therefore, it is important to situate language students in joyful learning contexts (Chen & Hsu, 2020).

Game-Based Learning (GBL) refers to learning through games in a digital or non-digital learning environment to enhance students' skills and knowledge (Wang & Zheng, 2020). In the past 2 decades, the use of game-based learning in different disciplines has increased, such as in chemistry (Wood & Donnelly-Hermosillo, 2019), programming languages (Topalli & Cagiltay, 2018), natural science (Herodotou, 2018), and language learning (Alfadil, 2020). Moreover, educational games have rapidly been developed for application in various learning environments, such as augmented reality (Hsu, 2017), virtual reality (Alfadil, 2020), digital games (Sung et al., 2017), and table games (Tsai et al., 2019) in recent years.

Previous studies have pointed out that game-based learning can improve students' learning effectiveness and motivation (Liu & Chu, 2010; Park et al., 2019; Ronimus et al., 2014). Park et al. (2019) designed an English vocabulary learning and arrow-shooting game. The results indicated that the proposed reward structure produced a statistically significant increase in the level of learning, motivation, and engagement. In addition, past research has included a meta-analysis of the cognitive and motivational effects of games. The results showed that the benefits of combining games with language learning are much greater than in other subjects (Wouters et al.,2013). Therefore, it can be known from the above studies that the use of games for language learning could more effectively improve students' learning effectiveness.

From the above studies, it can be seen that game-based language learning (GBLL) is gaining the attention of researchers. There are many reviews of past literature on game-based learning, as shown in Table 1. For example, Hwang and Wu (2012) analyzed the research trend of digital game-based learning (DGBL) from 2001 to 2010 and found that the number of DGBL articles increased significantly in the past decade. Tsai and Tsai (2018) reviewed the impact of digital games on the effectiveness of second language vocabulary learning and showed that digital games could effectively enhance students' vocabulary learning. Xu et al. (2019) analyzed 59 studies on digital games in English

Table 1.
Previous literature reviews listed by field of study

Author	Research Field	Sample	Time	Literature Review Focus
Boyle et al. (2016)	DGBL	143	2009-2014	This study updated Connolly et al.'s (2012) study and found that between 2009 and 2014, scholars became increasingly interested in the positive effects of digital games.
Hwang & Wu (2012)	DGBL	137	2001-2010	This study reviews the current and future trends of DGBL research from 2001 to 2010, and analyzes the research samples, subjects taught, and countries with the highest number of publications.
Hung et al. (2018)	DGBLL	50	2007-2016	This study reviews the current and future trends of DGBLL research from 2007-2016 and analyzes the research methods, digital games, target languages/learners and students' DGBLL outcomes.
Tsai and Tsai (2018)	DGBLL	26	2001-2017	This study reviewed the effect of digital games on second language vocabulary learning and analyzed eight dimensions, namely game design, educational level, L2 proficiency level, linguistic distance, intervention setting, assessment type, game source, and intervention length.
Xu et al. (2020)	DGBLL	59	2000-2018	This study reviewed the literature on digital games for English language learning and analyzed its participant characteristics, research methods, game features, and the correlation between game usability and game features.

language teaching and found that most of them examined the effectiveness of vocabulary learning and used quantitative research analysis.

Although there have been related review studies of DGBL and DGBLL in the past, with the explosive growth of technology in recent years, coupled with the impact of the COVID-19 epidemic, great changes in notations and approaches to using technologies in education, especially in the application of DGBL in language learning, have been observed (Kao, 2020; Serra & Gilabert, 2021). Moreover, those previous review studies only paid attention to limited dimensions of the game-based language learning studies, while several important dimensions, such as authors, countries, journals, keywords, learning strategies, and language acquisition were generally ignored. Therefore, the current study reviews the 30-year publications of GBLL research in technological contexts by interpreting the articles from diverse dimensions to provide more precise and complete analysis results.

This research referred to Lin and Hwang (2019) and comprehensively analyzed three aspects of DGBLL application, including research issues, performance issues, and interaction issues; moreover, each aspect is discussed and analyzed in detail. Scholars have identified three aspects that allow for better analysis of learners, technologies, and environments, especially in technology-based learning environments (Lai, 2020). The research issues consist of research methods, and learners' educational backgrounds and learning strategies. The performance issues consist of target languages, language acquisition, and affective or psychological states. The interaction issues consist of game genres and game-based learning environments/tools. Besides, the study analyzed authors, countries, journals, and keywords to generate a social network analysis figure using VOSviewer. Based on the data analysis, the hot spots of research on the application of GBLL are then listed. Finally, this study provides more references and development trends of GBLL applications as a reference for future research.

A systematic review of the literature was conducted to study the potential application of GBLL from 1989 to 2020, which includes the period of the global COVID-19 pandemic outbreak. The research questions of this study are as follows:

1. Who are the most-cited authors in articles on the application of GBLL?
2. What are the most-cited countries in articles on the application of GBLL?
3. What are the most-cited journals in articles on the application of GBLL?
4. What are the most-used keywords in articles on the application of GBLL?
5. What research methods, learners' educational backgrounds, and learning strategies were identified in the selected GBLL studies?
6. Were there any significant associations among the reviewed aspects with regard to game genres and game-based learning environments/tools in the selected GBLL studies?
7. What empirical evidence on student target languages, language acquisition, and learners' affective/psychological states was presented in the selected GBLL studies?

RESEARCH METHODS AND PROCESSES

Data Collection

This study adopted the two sets of keywords developed by Hung et al. (2018), including (A) gamified learning related keywords: "game-based learning," "GBL," "learning games," "serious games," "educational games," "game for learning," "video game," "gamification," "digital games," "game," "gaming," "gameful," and "gameplay," and (B) Language-related keywords: "language," "literacy," "reading," "writing," "listening," "speaking," "vocabulary," "grammar," and "pronunciation." The AND operator was used between the two sets of keywords, and the OR operator was used in the set.

The source of the research data collection was the Web of Science (WOS) from 1989 to 2020 and was limited to the two sets of keywords; the education-related field was "EDUCATION EDUCATIONAL RESEARCH," document type was "ARTICLE," and language was "English."

This study selected 10 journals included in the Social Science Citation Index (SSCI) to focus on the application of technology-assisted language education, including the British Journal of Educational Technology (BJET), Computers and Education (C&E), Computer Assisted Language Learning (CALL), Educational Technology & Society (ETS), Educational Technology Research & Development (ETR&D), the Journal of Computer Assisted Learning (JCAL), Interactive Learning Environments (ILE), Language Learning Technology (LLT), Recall, and System. The total number of bibliographic data retrieved was 210, and after manual screening, 109 papers were found to be unrelated to language or games, of which 57 were unrelated to language, eight were unrelated to games, 32 were unrelated to games and language, and 12 were literature reviews. Therefore, 101 papers related to GBLL were identified for analysis. The search procedure is shown in Figure 1.

Data Distribution

Figure 2 shows the published papers on the application of GBLL from 2007 to 2020. The first published paper was in 2007; subsequently, nine studies were published from 2009 to 2011, and 91 from 2013 to 2020. From Figure 2, it can be seen that game-based learning has been used increasingly in language education since 2013. This suggested that GBLL research is becoming popular and that some valuable research questions and findings have emerged. Young et al. (2012) analyzed GBL and found that the immersive environment created by games made learners more engaged in language learning compared to other subjects. Therefore, the application of GBLL is an effective and potential teaching method. Besides, Godwin-Jones (2014) proposed the advantages and challenges of applying various digital game types to language learning. For example, a widely discussed example of a game designed for language learning is Croquelandia. It shows an increase in students' awareness of meta-linguistic considerations and of the importance of pragmatic appropriateness. On the other hand, this study showed that when the game provides a certain level of complexity, more instructor intervention could be necessary. In addition, another wave appeared between 2016 and 2020, indicating that GBLL experienced some innovations in this period. For example, Dalton and Devitt (2016) used a three-

Figure 1.
The data collection procedure
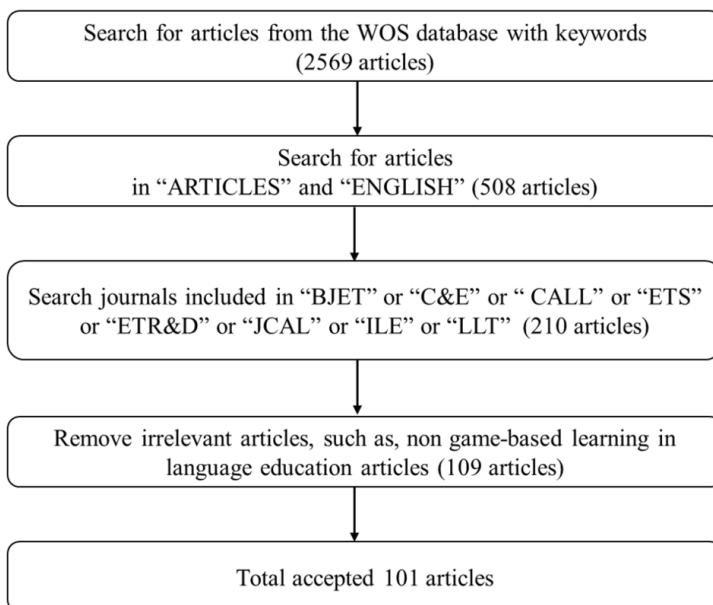
dimensional virtual environment (3DVE) in GBLL as a task for Irish language learning for elementary school students. Another study in 2020 pointed out that students improved their vocabulary skills and enjoyed a positive learning experience via a serious game (Chen & Hsu, 2020).

Coding Schemes

This study used VOSviewer to analyze information from the published papers on GBLL, including authors, countries, journals, and keywords. The main objectives were to understand which authors published more frequently on GBLL, which journals were most concerned with this area, and what keywords were used in this area.

Additionally, according to the technology-based learning model proposed by Lin and Hwang (2019), this study provided a learning model for GBLL, as shown in Figure 3. This study reviewed articles and coded them according to three aspects, that is, game, language, and learners. The coded items include research methods, learners' educational background, learning strategies, game genres, game-based learning environments /tools, target languages, language acquisition, and learners' affective /psychological states. The coding scheme is shown in Table 2, and the coding scheme for each orientation is described as follows.

Research Methods

This study analyzed the adopted research methods, including quantitative methods, qualitative methods, and mixed methods. Quantitative methods refer to the use of statistical methods to analyze and interpret data. Qualitative research usually uses questionnaires, interviews, and focus groups to obtain data. Mixed research is a combination of the two ways of conducting research (Connolly et al., 2012; Hung et al., 2018).

Learners' Educational Background

The learners' educational background was categorized into six age groups, namely preschool or kindergarten, elementary education, secondary education, higher education, cross-levels, and not
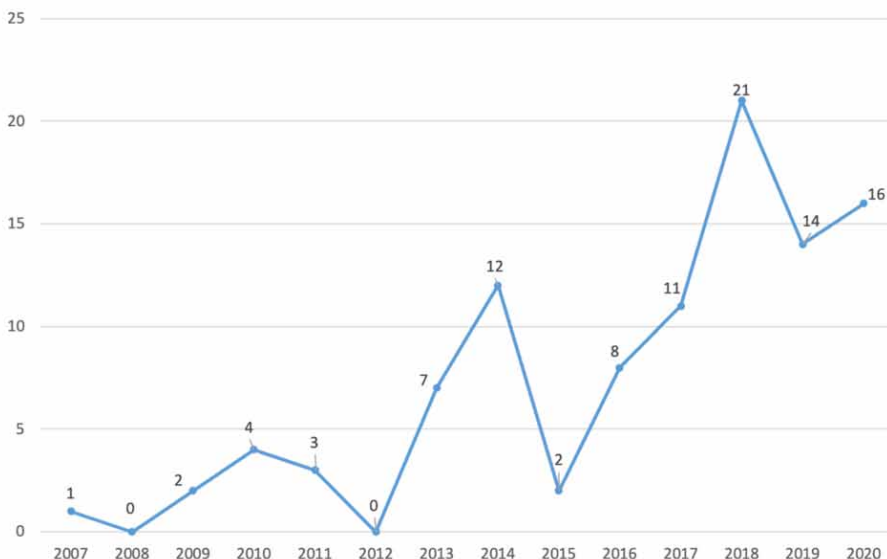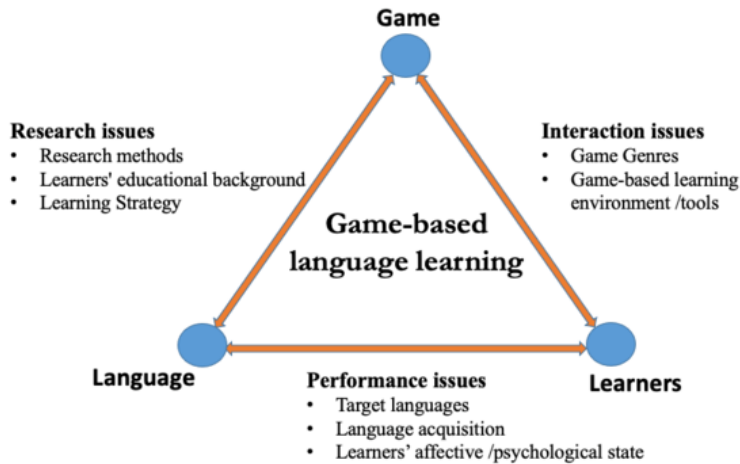
Figure 2.
The GBLL articles published from 2007 to 2020

Figure 3.
Review model for GBLL

specified. If the research object was cross-age, it was classified as cross-levels. For example, it was classified as cross-levels when the research objects were kindergarten and primary students (Hung et al., 2018).

Learning Strategies

The learning strategies were those proposed by Hwang et al. (2017), namely direct guided learning, peer assessment, collaboration learning, mind map, project-based learning, inquiry-based learning, and not used.

Target Languages

The target languages involved in the selected studies included English, Chinese, Spanish, German, Japanese, Italian, and others (Hung et al., 2018).

Language Acquisition

This study categorized language acquisition into the eight domains of listening, speaking, reading, writing, vocabulary, grammar, pronunciation, and integrated/whole language (Stockwell, 2007).

Learners' Affective or Psychological States

This study categorized the affective or psychological states into nine domains, namely general perceptions or attitudes, satisfaction, motivation/interest, engagement/flow, technology acceptance/ evaluation, self-efficacy/confidence, cognitive load, learning anxiety, and other affective states (Li & Tsai, 2013).

Game Genres

This study categorized the game genres into game types and the mobility of the games. The game genres were classified as simulation games, role-playing games, tutorial games, puzzle games, exergames, board games, gamification, and non-specified (Ke, 2016). Simulation games refer to games with simulated situations to guide students to learn. Role-playing games refer to the games that allow students to play a role in the storylines. Tutorial games refer to simple educational games, such as Q&A and shooting balloons for vocabulary learning. Puzzle games refer to the games that require

players to explore and solve some problems, such as puzzle games and room escape. Exer-games refer to somatosensory games, such as those using Xbox, VR, or AR technologies. Board games refers to the games using pieces located and moved on a pre-marked board on a table or a computer interface, such as Monopoly. Gamification refers to adding gaming mechanisms to learning design, such as rewards or competitions via scoring.

Game-Based Learning Environments /Tools

This study categorized the mobility of the game into five types of game technology applications, namely console or video games, computer or online games, mobile or ubiquitous games, mixed/varied, and not used (Connolly et al., 2012).

RESEARCH RESULTS

For the bibliometric analysis, VOSviewer was used to analyze the network visualization of author citations, countries' publication counts, journal publication counts, and the most commonly used keywords. VOSviewer is a software tool for building and visualizing the bibliometric network data. The program is freely offered to the bibliometric research community. Unlike most computer programs which do not present such maps in a suitable way, VOSviewer emphasizes the graphical representation of bibliometric maps. It can easily create bibliometric maps which can be interpreted in detail. The authors encoded the target language, the research method used, the game genres, the game-based learning environment (tools), the learners' educational backgrounds, the learning strategies applied, the learners' learning outcomes, and the learners' affective or psychological states.

The Most-Cited Authors

To understand the trend distribution of the authors' contributions, the analysis used VOSviewer, selecting citation analysis and authors. The minimum number of documents was set as 3, the minimum number of citations was 1, the number of authors was 6, and the result is shown in Figure 4. The connection line shows that Hwang, Gwo-Jen has close cooperation with Lin, Chi-Jen and Fu, Qing-Ke.

Table 2.
Encoding overview

Dimension	Category	Items
Research issues	Research Methods	quantitative method, qualitative method, mixed method
	Learners' educational background	preschool or kindergarten, elementary education, secondary education, higher education, cross-levels, not specified
	Learning Strategies	direct guided learning, peer assessment, collaboration learning, mind map, project-based learning, inquiry-based learning, not used, others
Performance issues	Target languages	English, Chinese, Spanish, German, Japanese, Italian, others
	Language Acquisition	Listening, speaking, reading, writing, vocabulary, grammar, pronunciation, integrated / whole language
	Affective or Psychological States	general perceptions or attitudes, satisfaction, motivation / interest, engagement / flow, technology acceptance / evaluation, self-efficacy / confidence, cognitive load, learning anxiety, other affective states
Interaction issues	Game Genres	simulation games, role-playing games, tutorial games, puzzle games, exer-games, board games, gamification, others
	Game-based learning environment /tools	console or video games, computer or online games, mobile or ubiquitous games, mixed / varied

The green node group includes Hwang, Gwo-Jen and Cornillie Frederik, whose research was about education-related technology research, computer-assisted learning, and learning-related analysis. The red node group includes Lin, Chi-Jen and Fu, Qing-Ke, whose research applied technology to enhance language learning, and EFL students' oral language and writing. The last blue node group includes Lyytinen Heikki and Ronimus Miia. Both scholars' research was related to language learning for students with dyslexia and children's language learning, focusing on the psychological aspects. The research areas of the three groups of the top six scholars are summarized in Table 3.

Table 4 demonstrates the top six most-cited authors in the GBLL literature. According to Table 4, the most-cited authors in the game-based learning studies in language education are Hwang, Gwo-Jen (Citations = 165, Documents = 7), Lyytinen Heikki (Citations = 99, Documents = 5), and Ronimus Miia (Citations = 68, Documents = 4).

The Most-Cited Countries

To understand the distribution of the most-cited countries, the analysis used VOSviewer, and selected citation analysis and countries. The minimum number of documents was set as 3, the minimum number of citations was 1, the number of countries was 12, and the results are shown in Figure 5.
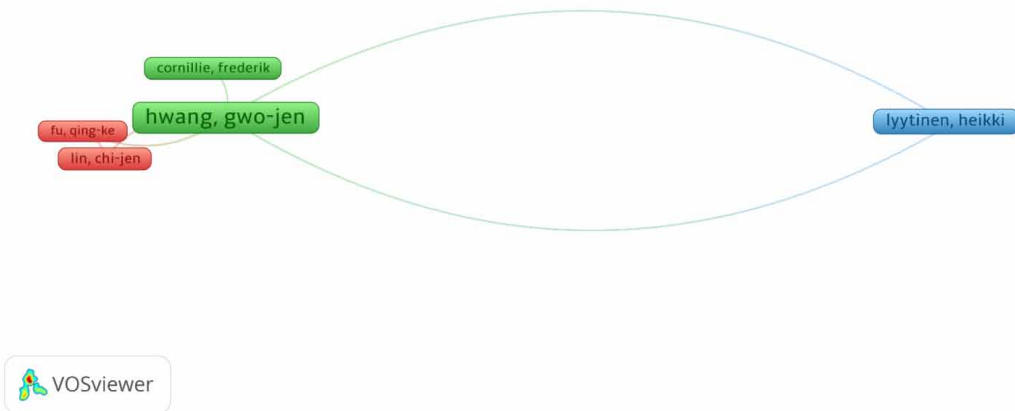
Figure 4.
The most-cited authors

Table 3.
The top six authors' research fields in the GBLL literature

Cluster	Author	Country	Research fields
Red	Hwang, Gwo-Jen	Taiwan	mobile/ubiquitous learning, digital game-based learning, artificial intelligence in education.
	Cornillie Frederik	Netherlands	second language acquisition, computer assisted language learning, learning analytics, educational technology.
Green	Lin, Chi-Jen	Taiwan	technology enhanced language learning, game-based language learning, flipped classroom, EFL student speaking and writing performance.
	Fu, Qing-Ke	Taiwan	EFL student speaking and writing performance, technology-enhanced learning, collaborative learning.
Blue	Lyytinen Heikki	Finland	language learning of students with dyslexia, the influence of family problems on language learning, children's language learning.
	Ronimus Miia	Finland	language learning of students with dyslexia, children's language learning.

Table 4.
The top six most-cited authors in the GBLL literature

Author	Documents	Citations
Hwang, Gwo-Jen	7	165
Lyytinen Heikki	5	99
Ronimus Miia	4	68
Lin, Chi-Jen	4	58
Cornillie Frederik	3	49
Fu, Qing-Ke	3	27

There are five clusters according to the marked colors, and the graph clearly shows the connections and collaborations among the countries. Among them, Taiwan stands out and forms the same cluster (red nodes) as Spain, the Netherlands, and Singapore, indicating that authors from these countries have similar research directions or patterns. Similarly, South Korea, Finland, and Germany form a cluster (green node), the United States and Sweden form a cluster (yellow node), Belgium and Turkey form another cluster (blue node), and China is a cluster on its own (purple node). Based on the connecting lines, it could be inferred that Taiwan has closer cooperation with China, South Korea, and the Netherlands.

Table 5 shows the most-cited countries in the GBLL literature. According to Table 5, the top three most-cited countries are Taiwan (Citations = 780, Documents = 38), the United States (Citations = 534, Documents = 19), South Korea (Citations = 138, Documents = 8), and Finland (Citations = 99, Documents = 7).

Besides, according to the recent years' distribution, as shown in Figure 6, it was found that the early major research countries on game-based learning in language education were the United States, South Korea, Singapore, and Germany. The countries that have produced the most recent research are China and Turkey.

Figure 5.
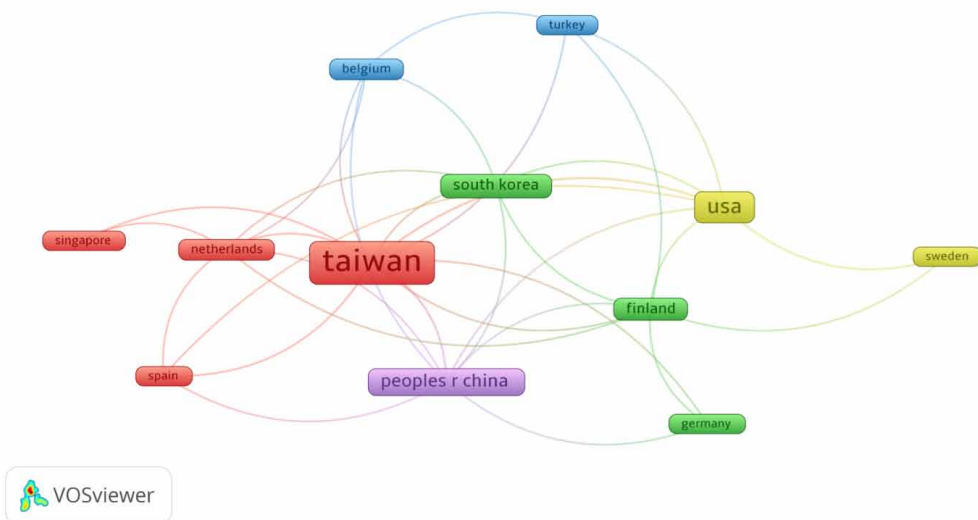**The clusters of the most-cited countries**

Table 5.
The most-cited countries in the GBLL literature

Country	Documents	Citations
Taiwan	38	780
USA	19	534
South Korea	8	138
Finland	7	99
Spain	3	95
Sweden	3	75
Netherlands	4	59
China	13	58
Belgium	4	49
Singapore	3	37
Germany	3	31
Turkey	3	13

The Most-Cited Journals

To understand the most-cited journals, the analysis used VOSviewer and selected citation analysis and source. The minimum number of documents was set as 2, and the minimum number of citations was 1, the number of journals was 10, and the results are shown in Figure 7. The most-cited journals were formed into three clusters. According to the colors, it was found that Computers & Education, the Journal of Computer Assisted Learning, Educational Technology & Society, and ETR&D-Educational Technology Research and Development were in the same cluster (green nodes), indicating that these journals had a close relationship.

Figure 6.
The distribution of the most-cited countries by years
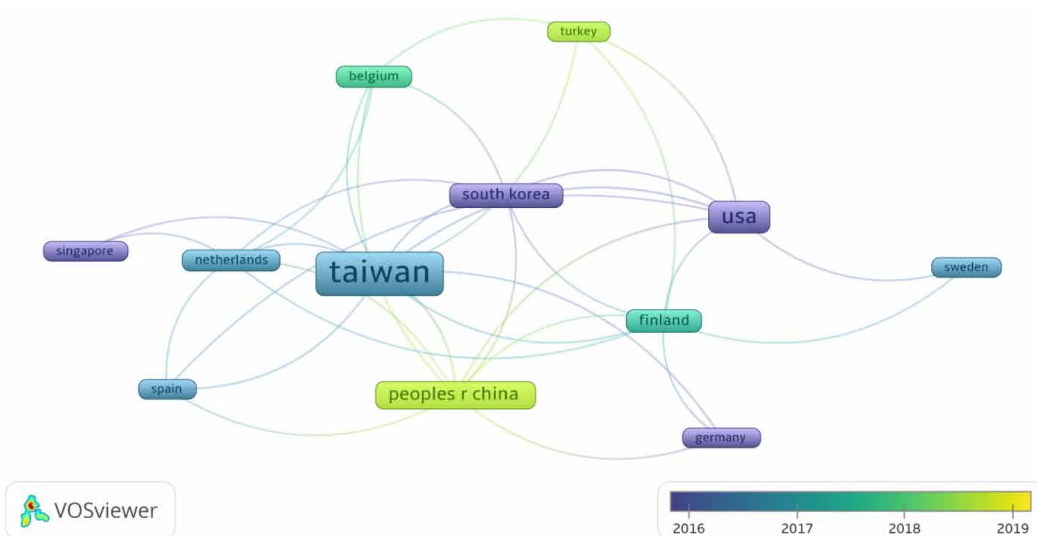
The most-cited journals are shown in Table 6. In terms of research on GBLL, the most-cited journals in order were Computers & Education (Citations = 881, Documents = 26), Computer Assisted Language Learning (Citations = 241, Documents = 15), and Language Learning & Technology (Citations = 238, Documents = 7).

The Most-Used Keywords

To understand the most-used keywords in the GBLL literature, the analysis used VOSviewer and selected co-occurrence analysis and author keywords. The minimum number of occurrences of a keyword was set as 2, the number of keywords was 37, and the results are shown in Figure 8.

The results show that each cluster comprised some popular terms and keywords, and some clear research trends came to light. The green cluster was on game-based learning, as the keywords of
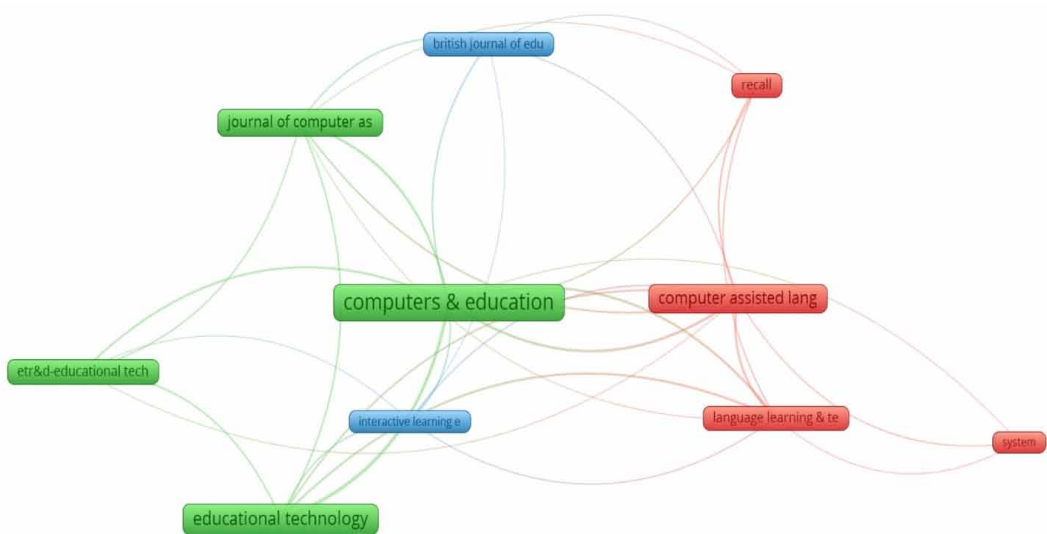
Figure 7.
The clusters of the most cited journals

Table 6.
The ranking of the most-cited journals

Journal	Documents	Citations
Computers & Education	26	881
Computer Assisted Language Learning	15	241
Language Learning & Technology	7	238
Educational Technology & Society	18	179
Educational Technology Research and Development	8	141
Journal of Computer Assisted Learning	11	131
Recall	6	125
British Journal of Educational Technology	5	111
Interactive Learning Environments	3	33
System	2	7

this cluster were all related to games. For example, computer games were the main types of games used in game-based learning. Moreover, many mobile learning activities also used games in learning activities or used mobile devices and computer-assisted language learning in game-based learning. Besides, the engagement rate, motivation, learning behavior, and anxiety were generally analyzed in game-based learning studies.

On the other hand, the red cluster focuses on the interactive learning environment and language learning, and related cluster nodes include some teaching strategies and tools such as competition, collaborative learning, flipped learning, simulations, and the categories of learners such as children and elementary education revealed that most of the studies focused on children and elementary education.

The analysis result of the most-used keywords is shown in Table 7. The most-used keywords in the GBLL literature are game-based learning (f = 32), computer games (f = 20), interactive learning environments (f = 19), language learning (f = 15), and learning strategies (f = 11).

Besides, the year distribution of the most-used keywords is shown in Figure 9. It was found that the early studies focused on English learning, e-books, computer-assisted language learning, and simulations. More recently, the research has gradually shifted to Second Life, children, intelligent tutoring systems, flipped learning, and engagement.

Research Issues

Research Methods

Figure 10 shows the most-used research methods among the 101 selected papers. The most-used research method was quantitative research (n = 71, 70%) which collected data mainly through questionnaires. About a quarter of the studies used mixed methods (n = 25, 25%) that combined quantitative and qualitative methods. A relatively small proportion of the studies analyzed were qualitative studies (n = 5, 5%) which used interviews or discussions to collect the data for analysis.

Figure 8.
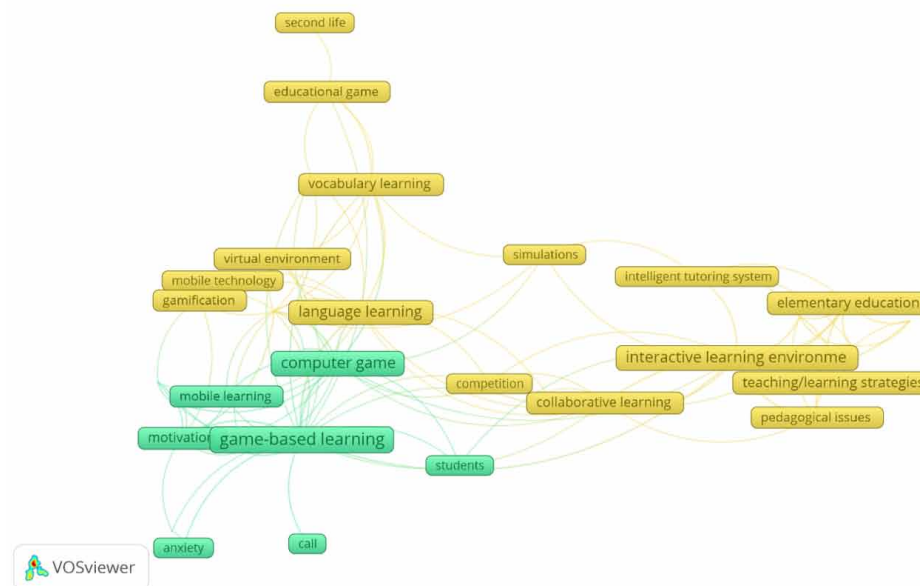**The cluster of most-used keywords**

Table 7.
The ranking of the most-used keywords

Keyword	Occurrences	Total link strength
game-based learning	32	38
computer game	20	33
interactive learning environment	19	46
language learning	15	25
learning strategies	11	29
English learning	11	19
elementary education	9	23
vocabulary learning	8	12
applications in subject areas	7	21
collaborative learning	7	16
motivation	7	13
gamification	5	7
improving classroom teaching	4	12
pedagogical issues	4	12
evaluation methodologies	4	8
mobile learning	4	7
virtual environment	4	6
Chinese character learning	3	6
engagement	2	6

Figure 9.
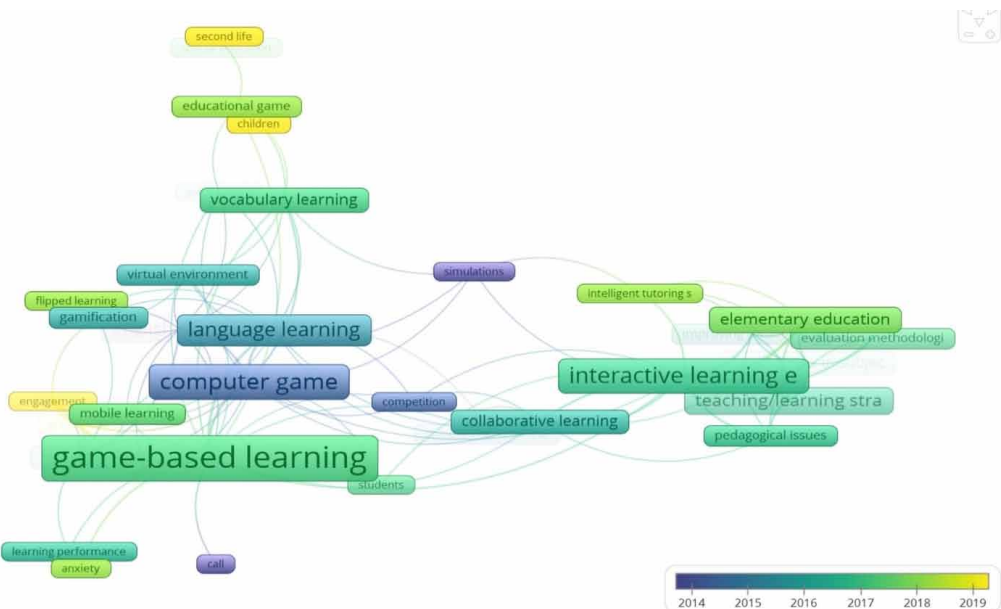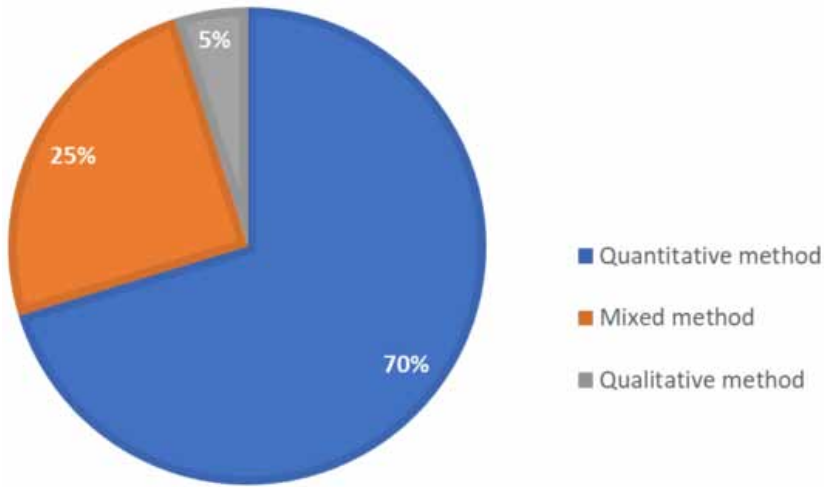**The distribution of the studies using the keywords by years**

Figure 10.
The distribution of research methods used in the GBLL literature


Learners' Educational Background

Among the 101 selected papers, the learning backgrounds of learners in the GBLL literature were analyzed, as shown in Figure 11. The results showed that the most studied learners' learning background was higher education (n = 50), followed by elementary education (n = 40), and secondary education (n = 6).

Learning Strategies

Among the 101 selected papers, the learning strategies used by researchers in the GBLL literature were analyzed, as shown in Figure 12. Results showed that "Not used" was the most frequent (n = 45), the next is "Inquiry-based learning" (n = 34), followed by "Collaboration learning" (n = 12). In "Others,"

Figure 11.
Learners' educational background in the GBLL literature
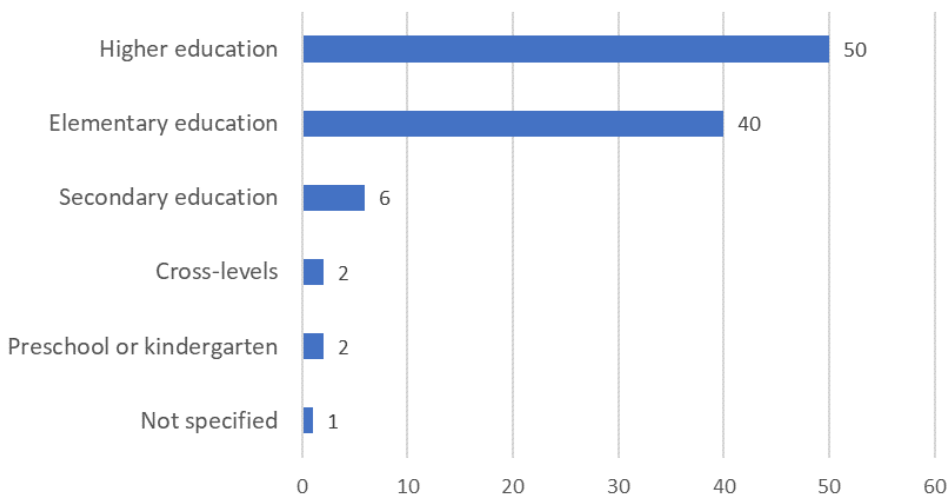
two studies used competitive strategies (Vandercruysse et al., 2013), one used competitive strategies combined with adaptive teaching (Wei et al., 2018), and one used proposed strategies for teaching (Hong et al., 2020). The highest number of "Not used" was due to the possibility that scholars considered game-based learning itself as a teaching strategy (Hwang et al., 2017). Inquiry-based learning allows students to find problems in the learning environment and use the knowledge gained to independently complete learning tasks. This learning approach effectively facilitates students' self-directed learning and allows them to use appropriate strategies to solve problems (Levy et al., 2009; Kuhn et al., 2000). As a result, many studies nowadays combine games to allow students to explore and solve problems in learning tasks on their own to foster active learning, enhance learning effectiveness (Rasti-Behbahani & Shahbazi, 2020; Wu, 2019), and promote reflective thinking (Lin et al., 2018).

By dividing the research into three separate time periods, it is shown that the adoption of "collaboration learning" began to grow between 2017 and 2020 (Figure 13). Most studies on game-based learning suggested that the competitive mechanism of games can enhance students' motivation to learn (Vandercruysse et al., 2013). However, the role of competition and collaboration was not clearly understood. After 2011, a growing number of collaboration-related studies emerged. Some researchers pointed out that it is a positive development to try to incorporate collaboration into games and to analyze their effects (Buchinger & da Silva Hounsell, 2018).

Performance Issues

Target Languages

Figure 14 shows the graphical distribution of the target languages in the GBLL literature. Research related to English learning accounted for 71% of all studies, while Chinese (10%) and other languages (9%) were next. The other languages included three Finnish, one Dutch, one Swedish, one Korean, one Persian, and one Irish study. As an interesting case, Li and Chu (2020) developed a gamified e-learning platform (RB) for children's reading which includes books in both English and Chinese, to enhance learners' motivation by earning badges, winning battles, and gaining points, and to analyze students' learning outcomes and preferences. The study had two target languages for learning and therefore it was classified as other. Besides, the results showed that most studies focused on English language learning, indicating that English is the language of main concern. This result is consistent with Chen's (2018) claim that English is still important to learners around the world in the era of globalization.
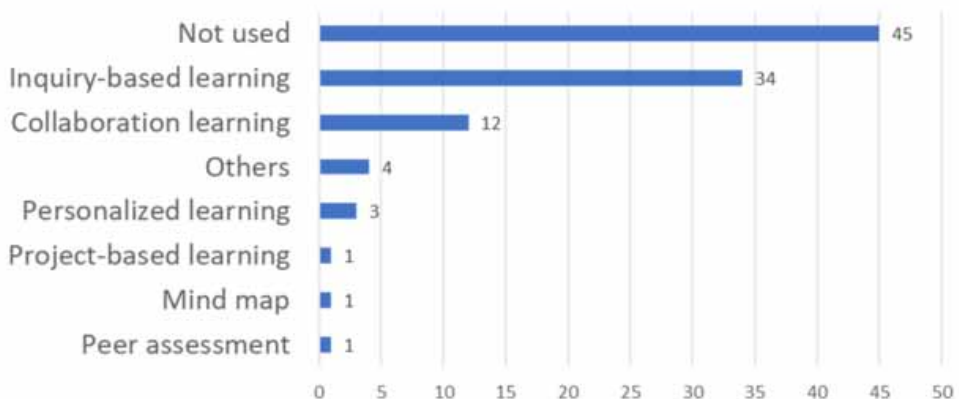
Figure 12.
Learning strategies in the GBLL literature

Figure 13.
Learning strategies in GBLL

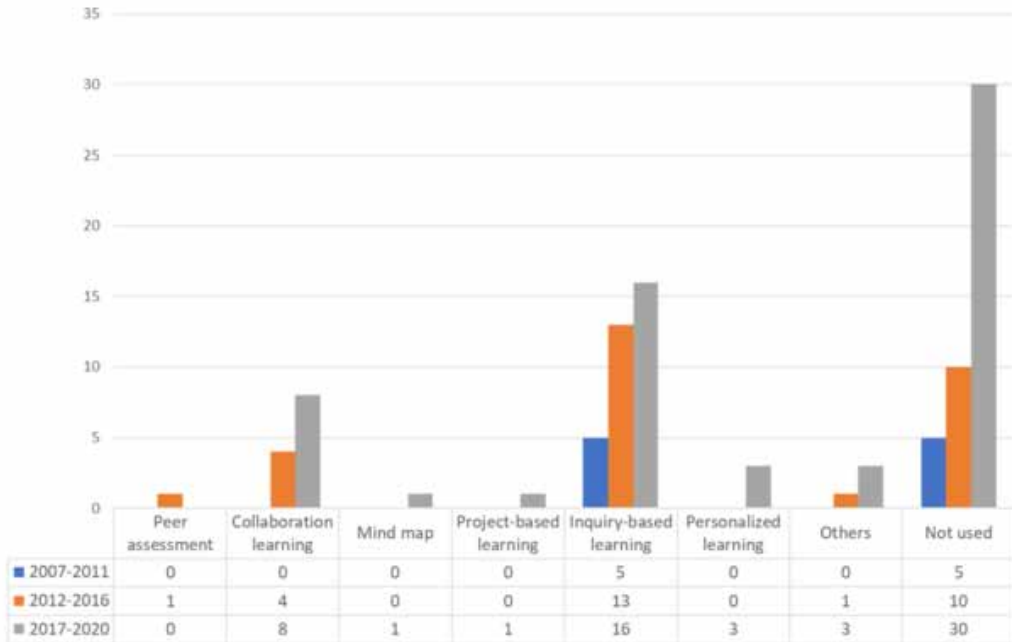|	Peer assessment	Collaboration learning	Mind map	Project-based learning	Inquiry-based learning	Personalized learning	Others	Not used
■ 2007-2011	0	0	0	0	5	0	0	5
■ 2012-2016	1	4	0	0	13	0	1	10
■ 2017-2020	0	8	1	1	16	3	3	30

Figure 14.
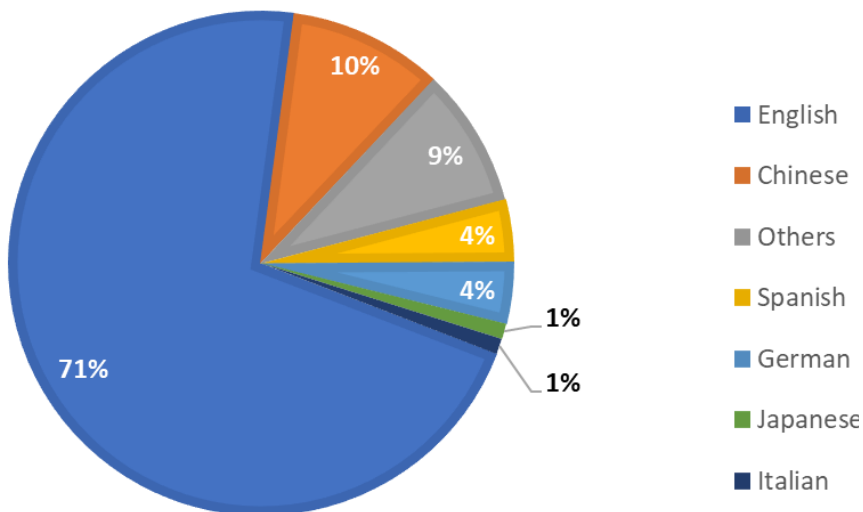**The distribution of the target languages in the GBLL literature**

Language Acquisition

The selected papers were analyzed to understand the learners' learning outcomes in the GBLL literature, as shown in Figure 15. Results showed that vocabulary (n = 49) was the most frequently selected item for analysis, followed by writing (n = 19) and reading (n = 19). It could be assumed

Figure 15.
**Learners' learning outcomes in the GBLL literature**
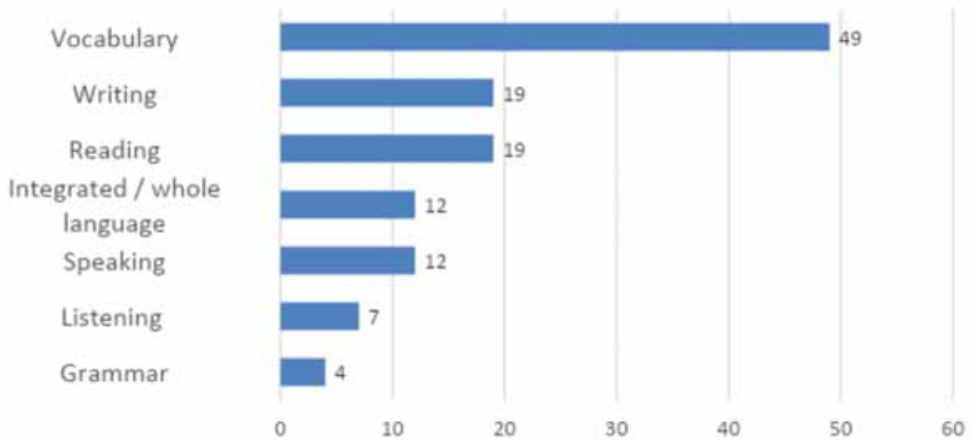
that most of the research is still in this direction because the word form is an essential component of sentences, and also, English writing and communication depend on the amount of vocabulary the user has (Alfadil, 2020).

Learners' Affective or Psychological States

Among the selected 101 papers, the learners' affective or psychological states were selected for analysis, as shown in Figure 16. Results showed that the most frequently selected psychological and affective items for analysis were motivation/interest (n = 43), followed by general perceptions or attitudes (n = 15) and self-efficacy/confidence (n = 11). However, only one of these studies was on technology acceptance/evaluation (Sung et al., 2017), suggesting that as technology has become more advanced and widespread, the number of studies using this item has decreased.

Figure 16.
Learners' Affective or Psychological State in the GBLL literature
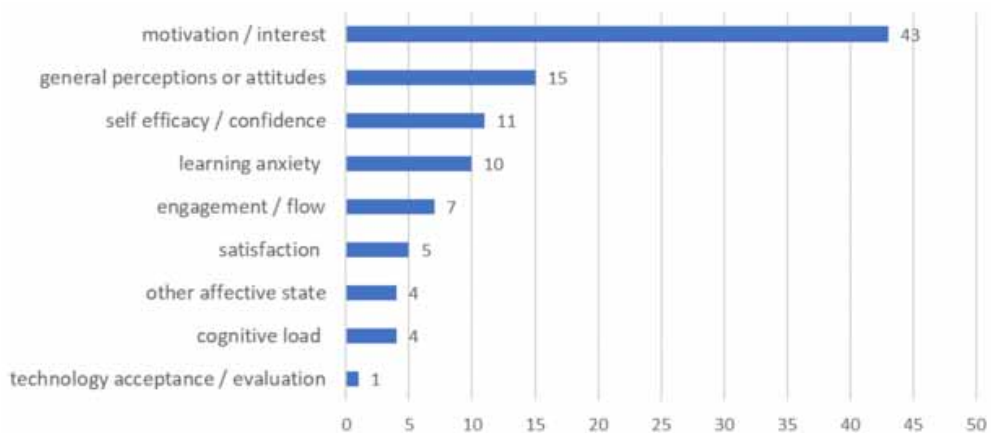
Interaction Issues

Game Genres

Among the 101 selected papers, the types of games used were analyzed, as shown in Figure 17. The results show that the most used game types were tutorial games (n = 27), followed by role-playing games (n = 25), simulation games (n = 16) and gamification (n = 16).

By dividing it into three time periods, it was found that between 2017 and 2020, the tutorial games increased the most, followed by gamification and simulation games. It could be inferred that tutorial games are easy to produce and can provide timely feedback (Niemela et al., 2020; Schremm et al., 2017; Zhonggen, 2018;). Gamification is the mechanism which can incorporate joy, reward, and competition when developing educational learning activities (Kim et al., 2018). Simulation games could provide students with meaningful associations, present real scenes, and give immediate feedback (Jones, 1986; Purushotma, 2005).

Game-Based Learning Environments /Tools

The most-used learning environments/tools in the GBLL literature were analyzed as shown in Figure 18. The results showed that computer or online games were the most popular (n = 69), followed by mobile or ubiquitous games (n = 29) and console or video games (n = 2). For example, Wu, Chen, and Huang (2014) developed a digital board game for Taiwan high school students to enhance their English communication skills as well as a board game to compare their learning outcomes. Since the study used two platforms, it was classified as mixed/varied.

By dividing the research into three time periods, the results showed that computer or online games were the most-used in the learning environment. However, mobile or ubiquitous games showed a significant increase after 2011, which is presumably related to the mobile technology fluctuations between 2010 and 2011 mentioned by Bozkurt (2020).

Figure 17.
Game Genres in the GBLL literature

	simulation games	role-playing games	tutorial games	puzzle games	exer-games	board games	gamification	others
▪ 2007-2011	2	5	2	0	0	0	0	1
▪ 2012-2016	3	8	6	2	4	2	4	0
▪ 2017-2020	11	12	19	1	3	1	12	3
▪ Total	16	25	27	3	7	3	16	4
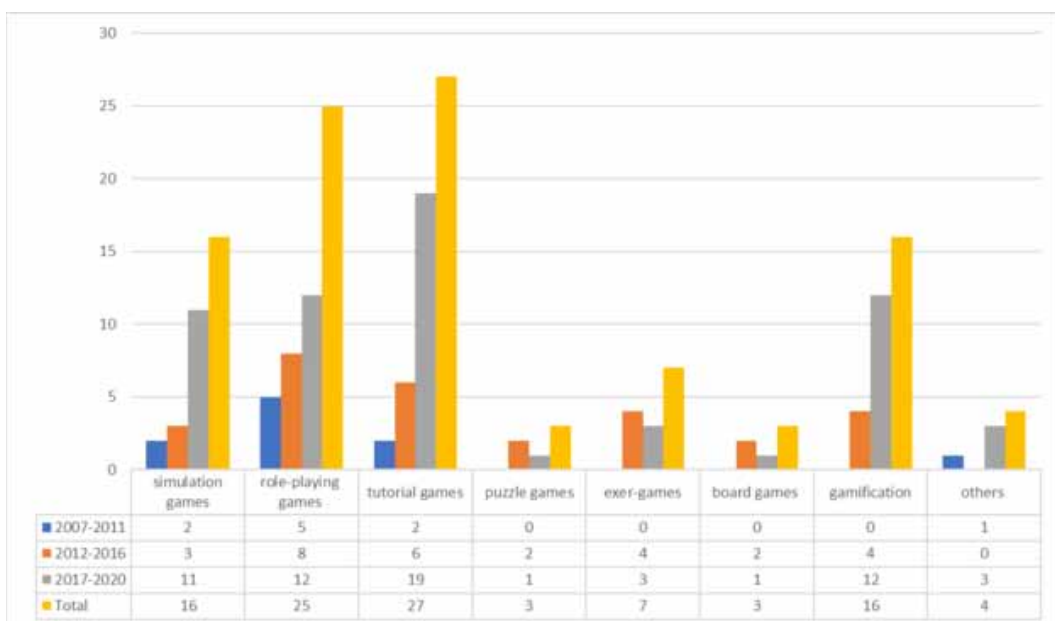
Figure 18.
Game-based Learning environments (tools) in the GBLL literature

	console or video games	computer or online games	mobile or ubiquitous games	mixed / varied
■ 2007-2011	1	8	1	0
■ 2012-2016	0	18	10	1
■ 2017-2020	1	43	18	0
■ Total	2	69	29	1
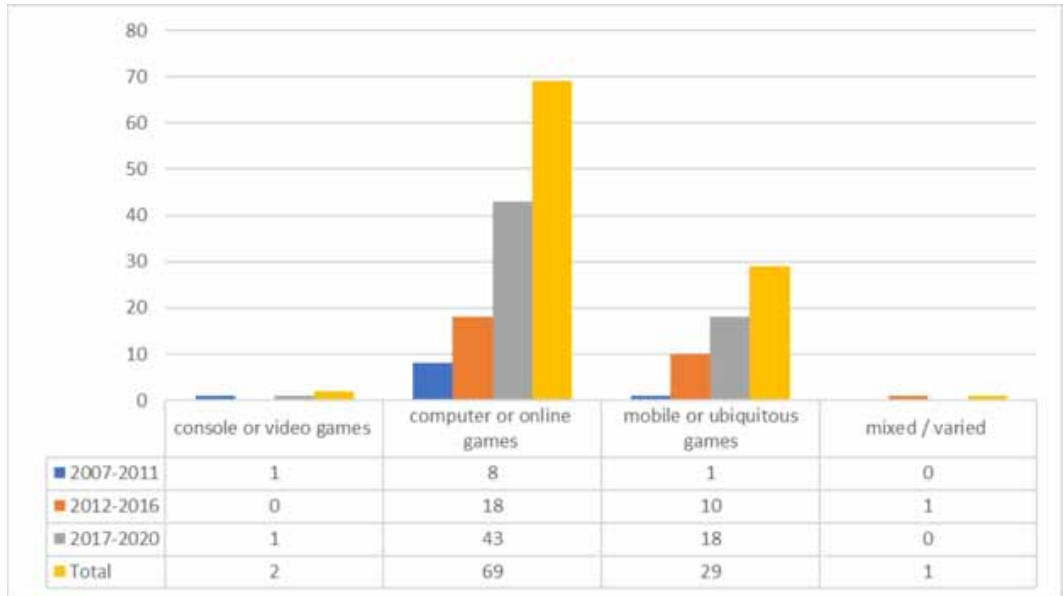
DISCUSSION AND CONCLUSION

To explore the trends of GBLL, this research used VOSviewer and coding for analysis. The study analyzed the most-cited authors, the most-cited countries, the most-cited journals, and the most used keywords in studies through the social network analysis. Through coding, the authors analyzed the most focused-on target language, the most frequently used research methods, game genres, the game-based learning environments, the target of learners' educational backgrounds, the learning strategies, learners' learning outcomes, and learners' affective or psychological states.

According to the above research results, the author with the greatest contribution to GBLL research was Huang, Gwo-Jen. His citation rate reached 23.5%. Two scholars followed: Lyytinen Heikki with a citation rate of 19.8% and Ronimus Miiau with 17%. Figure 5 shows that Taiwan had the highest number of publications. In terms of authors, Huang, Gwo-Jen had the greatest contribution and comes from Taiwan which had the largest number of publications on GBLL. Therefore, there is a close connection between the author and the country. Moreover, Taiwan is promoting the integration of information into teaching, and many related applications have been proposed, such as using digital games, augmented reality, and virtual reality. Integrating technology-related applications into teaching has become a current research trend in Taiwan, and many scholars have begun to explore applications of different technologies and disciplines (Alfadil, 2020; Chu et al., 2019; Sung et al., 2017).

The most-cited journal among the sampled journals publishing GBLL research is Computers & Education. Based on the number of studies, it is known that Computers & Education is currently the most-cited journal, with a citation rate of 33.2%. The second is Computer Assisted Language Learning with a citation rate of 17.2%, while Language Learning & Technology has a citation rate of 34%. It is worth noting that although Language Learning & Technology has published only seven studies, its citation rate is higher than the previous two. This may be due to the focus of Language Learning & Technology on language education; if scholars want to research language education, most will first look for research trends in Language Learning & Technology. Computers & Education and

Computer Assisted Language Learning include more science subjects and applications, and so it may be difficult to find the most suitable application for language education.

Regarding the research issues, the most-used research method was quantitative research, which collected data mainly through questionnaires. Although qualitative studies are rare in GBLL, there is still a significant amount of literature that analyzes meaningful research. For example, Dickey (2011) combined narrative design in an adventure-style game learning environment based on grounded theory to cultivate the argument and persuasiveness of college students. The results showed that intrinsic motivation and curiosity can support such games, and can be maintained through narrative and environment, and that they are beneficial for similar learning environment designs. This result also suggested that future research should focus more on the relationship between the learners' perspectives, narrative procedures, and curiosity. The quantitative analysis allowed for an objective and systematic analysis of data; therefore, the evaluation of learner performance was mostly based on tests/exams; however, the use of qualitative analysis (e.g., interviews or open-ended questions) could provide an understanding of students' learning and perceptions of GBLL. Therefore, it is argued that researchers should choose appropriate analytical methods for this direction in order to explore different dimensions, for example, using mixed methods.

According to the coding scheme, it can be known that fundamental education and higher education were the main research samples. This finding is consistent with the analysis conducted by Hwang and Wu (2012) in the context of broader GBLL. It may be because most researchers believe that fundamental education and higher education learners are the majority users of digital games. Fundamental education is a critical period for students to learn English. Their interest can be cultivated by learning while playing. Higher education students are such regular and experienced gamers that they can improve their learning achievement in a familiar environment.

In terms of performance issues, English as an international language is also the most popular language in an increasingly globalized world. Although this study did not explore the learning and use of digital games in native and non-native languages in any language, in countries where the native language is not English, the opportunities to speak or listen to English are limited. Therefore, scholars hope to establish an environment where students can have the opportunity to practice their English skills through games (Lin et al., 2018). On the other hand, there is a lack of digital games for less widely learned languages (for example, Japanese, Korean, Italian). In the future, researchers can try to apply GBLL to different languages.

From this research, the vocabulary is the language achievement researched by most scholars. This result is consistent with Hung et al.'s (2018) finding. Therefore, it is inferred that vocabulary is the basis of language education. No matter what language it is, vocabulary is required before further learning. Besides, it is worth noting that there are only a few studies on listening and grammar. Although there is some research on the oral aspect, no studies have explored pronunciation. It may be because the teaching of pronunciation is difficult to integrate into games. If there is no relevant mechanism in the game to provide feedback, it is a challenge for students to improve their pronunciation through the game. Therefore, it is suggested that more research is needed to explore how language achievements such as pronunciation, listening, and grammar improved through games.

However, this research infers that, compared with traditional classes, game-based learning is still not popular in schools. Therefore, if game-based learning can significantly enhance students' learning motivation or interest, teachers will be more confident in integrating digital games into teaching. When students can enhance their learning motivation or interest, they will be more willing to learn, thus achieving the effectiveness of teaching. On the other hand, it was found that there were fewer cognitive load studies in the literature analyzed in this research. Therefore, more research may be needed in the future to explore the cognitive load aspects.

In terms of interaction issues, in addition to computer games or online games, it can also be seen that the use of mobile and ubiquitous games is growing. With the current technological advancement and teaching trends, mobile and ubiquitous learning (for example, using mobile phones or tablets)

seems to have become a substitute for computers, making language learning more convenient and not restricted by time and space. As scholars have noted, mobile technology is seen as a wider educational application that could provide users with personalized information, adaptive assistance, and a real-time platform for social interaction (Lai, 2019). Therefore, we suggest that future research can move towards mobile games, enabling students to learn ubiquitously through mobile technology.

The main purpose and contribution of this research were to analyze the relevant studies on GBLL and propose possible future research. The progress of GBLL can promote the development of language education. Therefore, finding suitable game genres, game environments, and teaching strategies to assist learners in learning knowledge and skills in language education is very important. How to enhance the development of language education through GBLL is worth studying. Moreover, games are a medium like books. There are different types of games for learning. With the rapid enhancement of technology, it is suggested that future studies develop Metaverse-based games such as blockchain games, NFT games, crypto games, and VR/AR games.

When interpreting the above findings, some limitations should be considered. The search terms, the journals selected, and the publication periods used in this research may have ignored other potential papers and may not represent all research trends. Although not exhaustive, the coding scheme developed in this research does provide classification and analysis of the use of digital games in language education from multiple perspectives. Therefore, it is recommended to conduct a more comprehensive search to review more studies over a longer period of time.

ACKNOWLEDGMENT

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