



# Games Applied to Vocabulary Learning: A Bibliometric Analysis on Two Decades of Research

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## Abstract

*In recent years, the emergence of digital games has had an impact on various educational fields, especially on the motivation and engagement in language learning. This study aims to analyze the latest research trends in game-based learning and gamification applied to vocabulary learning in terms of geographical production, intellectual, social and conceptual structures of the research in this field. A bibliometric analysis was conducted on 125 selected documents published between years 2000 and 2020. The main research findings show that one-quarter of the studies related to gamification and vocabulary learning were conducted in Taiwan, followed closely by the United States. However, collaboration between research institutions and countries is relatively limited. The results also identify influential researchers in the field and the collaborations. Additionally, the themes of “gamification”, “game-based learning”, “language learning”, “vocabulary”, “vocabulary learning”, and “collaborative learning” have attracted significant attention from researchers during these 20 years. Finally, based on publication trends and underdeveloped themes, this study provides suggestions for future research in the field.*

**Keywords:** *Bibliometrics, Game-based learning, Gamification, Vocabulary learning*

## Introduction

Learning a language, especially a foreign language, can be a difficult task. El-Omari (2016) identified four major factors that have a significant impact on students' achievement in language learning: attitudinal, social, socioeconomic, and extracurricular. An important element of language learning is vocabulary learning (Schmitt, 2008), which is necessary for an effective communication

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(Nation, 2001), as well as academic performance (Laufer, 2001; Oberg, 2011). Vocabulary acquisition is also a vital part of language comprehension and production (Brown, 2000; H.-J. H. Chen et al., 2020; Mashhadia & Jamalifar, 2015). Additionally, vocabulary acquisition is an essential part of reading (National Development Council [NDC], 2021; Tang, 2020) and vocabulary has a decisive impact on reading comprehension (Baumann, 2009; C.-M. Chen & Li, 2010; Mancilla-Martinez & Lesaux, 2010; Song & Hwang, 2022). Stahl (2005) pointed out that vocabulary implies not only the meaning of the words, but also how the words fit into the world. However, students often face difficulties at learning and remembering vocabulary, like in elementary school (Yunus et al., 2020). For example, some students perceive that memorizing English vocabulary is a boring learning activity (C.-M. Chen & Chung, 2008) and requires focusing on the nuances of the meaning of words (Zou et al., 2021). Additionally, vocabulary learning can be difficult when teachers have limited strategies and rely on books as the only teaching materials (Kusuma et al., 2017). In recent years, some researchers have studied the impact of new technologies in language learning. For example, R. Zhang and Zou (2022) identified five main types of technologies for second and foreign language learning: mobile learning technologies, multimedia learning and socialization, speech-to-text and text-to-speech recognition, and digital-game-based learning. They also presented four major purposes and benefits of advanced technologies: promoting practices, delivering instructional content, facilitating interactions, and restructuring teaching approaches. Concordantly, H.-J. H. Chen et al. (2020) indicate how technology has changed how languages can be acquired. Overall, as Tang (2020) points out, game-based learning is beneficial and effective in vocabulary learning.

One way to study the evolution of research in this field is through bibliometric analysis, a methodological approach that examines a specific number of published documents within a database (Camuñas-García et al., 2023). It provides precise quantitative analyses regarding the volume and distribution of research generated by scholars, institutions, and countries, as well as the intellectual and social structures of the field, including the networks between researchers and the influence of some scholars on others. Moreover, it identifies the most important topics and themes, providing both performance analysis and science mapping (Trinidad et al., 2021). In recent years, a number of scholars have used a bibliometric approach to study research on language learning (X. Chen, Hao, et al., 2018; X. Zhang, 2020; R. Zhang et al., 2020), and games in education (Camuñas-García et al., 2023; Martí-Parreño et al., 2016; Trinidad et al., 2021). However, there is a research gap specifically on games applied to vocabulary learning, and the purpose of this study is to analyze the

recent research trends in this topic. More specifically, this research aims to answer the following research questions:

- RQ1: What is the volume and distribution by geographic source of research?

This involves the knowledge of what and where the studies have been generated in terms of countries and institutions involved in the research.

- RQ2: What is the intellectual and social structure of research?

This encompasses which authors have had more impact in the field in terms of citations between researchers, and the collaboration between scholars.

- RQ3: What is the conceptual structure of research?

This includes the topics that have attracted the most attention between scholars and how the topical trends have evolved over time.

### **Games and Vocabulary Learning**

As games are an increasingly important part of today's society (Chang et al., 2020), it is no surprise that they are being used in education. Although there are different approaches to define terms related to games in education, Plass et al. (2015) points out that the term game-based learning refers to games with defined learning objectives, which is different from gamification (the use of game elements like awarding points in a learning setting). Therefore, this study takes into account a broader concept of games, including both game-based learning and gamification. In simple terms, game-based learning (GBL) can be defined as the process of learning by means of game playing (Annetta, 2010; Liu et al., 2021). This definition comprises both a playful activity with certain rules and outcomes, as well as having educational objectives (Ke, 2016; Klopfer et al., 2009). In GBL, gameplay defines the learning outcomes (Tang, 2020). GBL has been the object of various studies by researchers (Dicheva et al., 2015; Huang & Hew, 2018; Qian & Clark, 2016; Subhash & Cudney, 2018) and gaming has been regarded as significantly useful for language development (Reinders & Wattana, 2014; Sandberg et al., 2014) and language learning (Y.-L. Chen & Hsu, 2020; R. Zhang & Zou, 2022). During recent years, many researchers and practitioners have utilized different types of gaming applied to language learning, because GBL allows language learning instructions and activities to be situated and reinforced by game mechanics (Yukselturk et al., 2018). However, Hung et al. (2018) point out that research in this field tends to be fragmented, focusing on different aspects of learning and in different situations. Reinders (2012) explains that games have features that are especially relevant for language learning. For example, Wu and Huang (2017) developed a mobile game-based English vocabulary practice system that showed higher learning interest, attention, learning effectiveness, and a sense of accomplishment and triumph, compared

with the control group. Overall, Zou et al. (2021) found that GBL has positive effects in both short-term and long-term vocabulary learning, enhancing reading and listening comprehension, increasing motivation and engagement, reducing anxiety and encouraging interactions among students.

Furthermore, some meta-analytic research has addressed the relation between game-based learning and vocabulary learning. For example, Chiu et al. (2012) discovered that meaningful and engaging games provided a larger effect size than practice games. M.-H. Chen, Tseng, et al. (2018) point out that games should be fun and challenging to be effective for language learning, regardless of the learners' age and linguistic background. Meanwhile, Tsai and Tsai (2018), evaluating different scenarios and factors, conclude that GBL can enhance and motivate vocabulary learning. Finally, Peterson (2013) analyzed early and contemporary literature regarding computer games and language learning, and concluded that the majority of research suggest that computer games (both commercial and purpose-built) are viable instruments for computer-assisted language learning in both institutional and informal out-of-school settings, that network-based games provide benefits like development of intercultural skills and interaction management, and that games have positive learner feedback and attitudes, motivation and enjoyment, among other benefits. However, the authors also point out some challenges, like the careful preparation, access to technology (like computers and internet), teacher training, and game selection.

## **Method**

The present study uses bibliometric analysis as the research methodology. Bibliometric, also known as statistical bibliography, consists of a quantitative study of physical published units (Broadus, 1987) in order to describe distribution patterns of research articles regarding a given topic and a given time period (Yang et al., 2012), therefore being able to identify relevant researchers, institutions or research categories in a subject of study (Martí-Parreño et al., 2016).

To answer the research questions specifically, this study implements a series of bibliometric analyses:

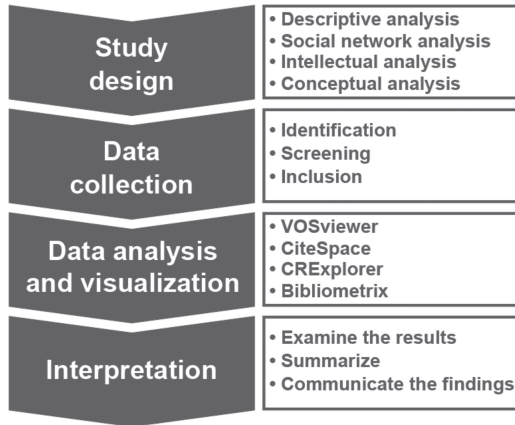
- A descriptive analysis of the volume and distribution of research, according to geographical sources. Trinidad et al. (2021) explain that this type of analysis helps to understand the performance of different institutions and countries, thus providing a general view of the situation and evolution of research publications.
- An intellectual and social structure analysis of research. As described by Martí-Parreño et al. (2016), this involves analyzing the different collaboration networks between researchers, and how authors influence each other.



- A conceptual analysis of research. This is the study of the key topics in the field in terms of their relations and evolution, usually by means of keyword analysis (X. Zhang, 2020).

To perform this bibliometric analysis, we follow the workflow suggested by Zupic and Čater (2015) consisting in study design, data collection, data analysis and visualization, and interpretation, as summarized in Figure 1.

**Figure 1 Process followed in this study**



## Study Design

Based on our research questions, we applied the relevant methods to answer them: descriptive analysis (by means of production counting, citation analysis), social network analysis (co-authorship network), intellectual analysis (co-citation network), and conceptual analysis (keyword analysis, thematic mapping).

## Data Collection

The present study includes documents that comply with the following research criteria:

- Database: Scopus. Although every citation database has its own advantages and limitations (Shah et al., 2017), Scopus was selected as it contains extensive information (Agbo et al., 2021; Cheng & Tsai, 2020), and its automatic search makes it easy to use (Ramirez & Rodriguez, 2019). Camuñas-García et al. (2023) also point out the vast number of studies in the fields of social sciences and humanities included in Scopus, making it a suitable database for the present study.
- Keywords: (language AND learning) AND (vocabulary) AND (game-based AND learning) OR (gamification).
- Publication date: from 2000 to 2020.
- Publication type: articles, conference papers, reviews, book chapters.

We followed the PRISMA workflow for systematic reviews (Moher et al., 2009), consisting in three consecutive steps: identification, screening, and inclusion. Documents yielded in the initial identification search applying the aforementioned criteria were then carefully screened to discard duplicates and those not related to the research topic; this resulted in the final list of inclusion.

### **Data analysis and Visualization**

The data retrieved from the included documents were analyzed using descriptive statistics, as well as bibliometric mapping with VOSviewer version 1.6.10 (van Eck & Waltman, 2019) and CiteSpace version 5.8.R3 (C. Chen, 2006); reference citation visualization was carried by means of CitedReferencesExplorer, also known as CRExplorer in order to identify influential publications in the field version 1.9 (Thor et al., 2018); additionally, Bibliometrix version 3.1, an R-package for science mapping analysis (Aria & Cuccurullo, 2017) was processed in RStudio version 2021.09.1 Build 372 by means of the Biblioshiny R-tool shiny web interface (R Core Team, 2021). Additional data visualization was performed using Microsoft Excel version 16.61, and Adobe Illustrator version 26.3. Inconsistencies in the results yielded among different software were resolved by the authors by rechecking the data.

### **Interpretation**

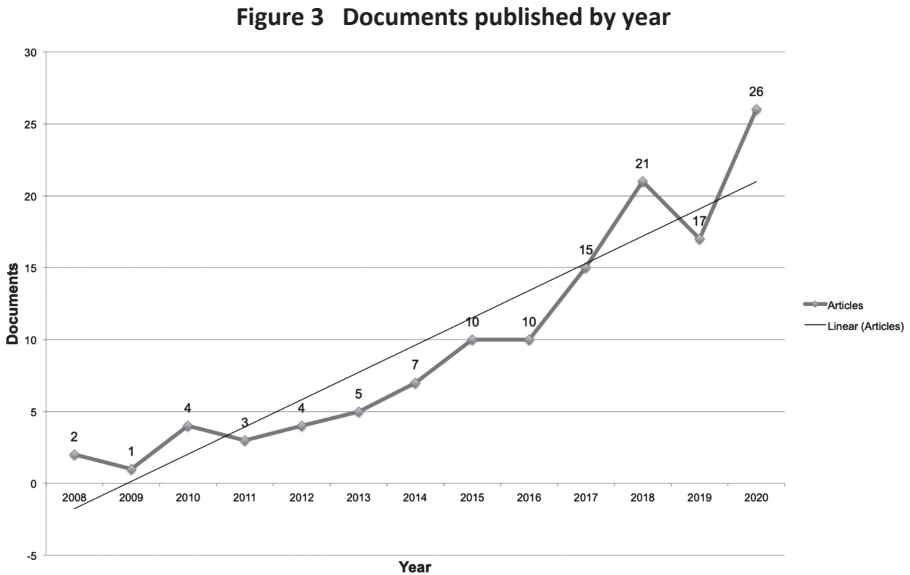
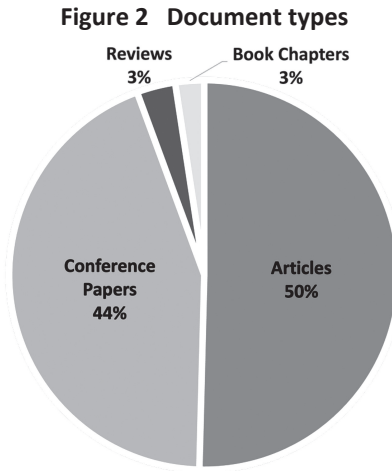
We selected and examined relevant information extracted from the results in order to summarize and reflect on the main findings, leading to the conclusions of our research.

## **Results and Discussion**

### **Descriptive Analysis: Volume and Distribution of Research**

After performing the data collection, the initial identification search yielded 132 documents, and after further screening 7 files were discarded for not being related to the topic, thus the final number of documents included in this study is 125: 63 articles, 55 conference papers, 4 reviews and 3 book chapters, as illustrated in Figure 2. This shows that the bulk of academic production of the studied topic found in the Scopus database comprises either journal articles or conference papers, which is consistent with the fact that 94% of Scopus' titles are journals.

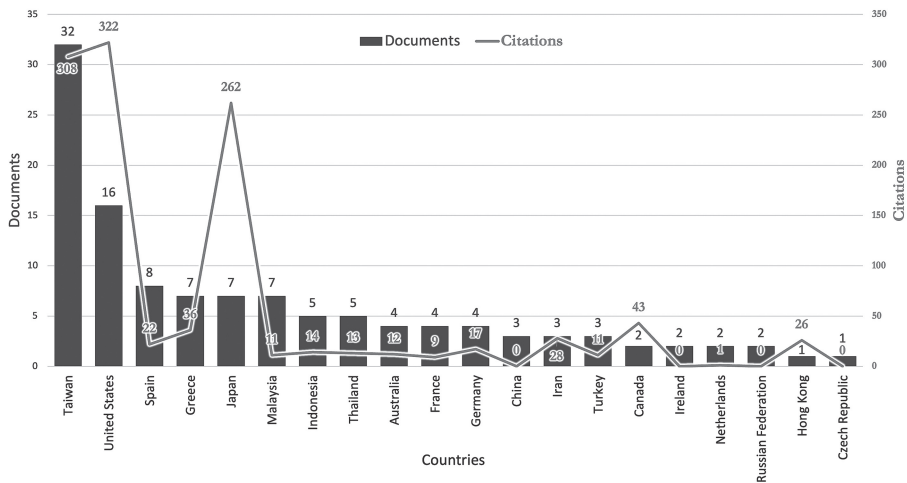
As we can see in Figure 3, there is a constant progression in the number of documents published each year; the trend line clearly shows that. From year 2000 to 2007 there are no documents that matched the search criteria, so from here on the data will cover the time span from 2008 to 2020. The increase in the number of studies (annual growth rate: 23.83%) is consistent with the findings by other authors (Zou et al., 2021).



As for the origin countries of research, 118 out of the 125 documents included in this study stated their country or region, and the top 20 countries presented in Figure 4, which also shows how many citations the papers from each country received. Taiwan was found to have a significant dominance in terms of document production, with 32 papers out of 118 (27.11%) being generated from Taiwan. This result is consistent with a previous study by Zou et al. (2021). This phenomenon is interesting in the context of the increase in schools teaching English as a foreign language in Taiwan (Ku, 2019; Tseng et al., 2019), which is caused by the current Taiwanese government’s policy to transform the country into a bilingual nation by 2030 (NDC, 2021; Tang 2020). However, when GBL is studied in the context of other fields besides language learning,

such as mathematics or programming, the United States has generated more studies (Tao et al., 2018). It is important to note that document production is not always directly correlated to citations, as shown in the data present in Figure 4. For example, the papers published by the United States, despite being half of those from Taiwan, were in fact cited more; Japan, Canada, and Hong Kong also have high citation numbers, despite having similar document production to other countries and regions. Upon closer inspection of the documents, it was found that the citation count for some papers authored by multiple authors from different countries was multiplied for each country. This is the case, for example, of the paper by deHaan et al. (2010), in which two of the authors are from the United States and the other from Japan, hence the 107 actual citations of this document for each country were counted as 214 citations for the United States and 107 for Japan.

**Figure 4 Document Production and Citations Per Country**



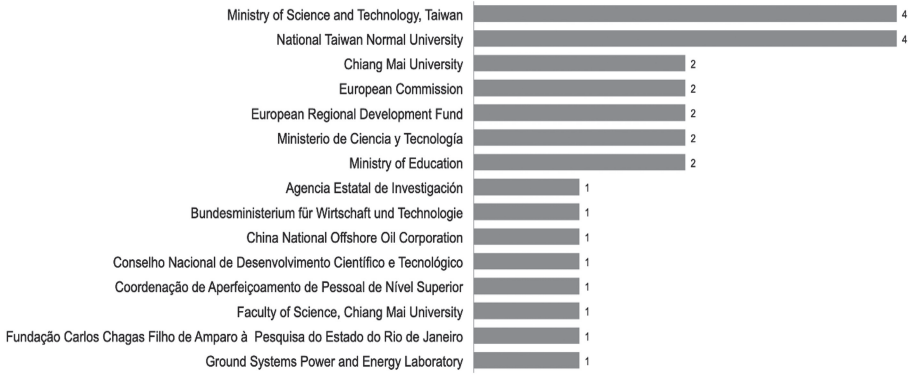
Funding can have an impact on the volume of studies produced. Figure 5 shows the number of documents published by the top 15 funding sponsors; apparently there is no major source of funding. The two bigger sponsors (again Taiwanese institutions) have only funded four documents each, thus not making a big impact in general, since it's eight papers out of the 125 included in this study.

**Social and Intellectual Structure of Research**

We analyzed how authors relate to each other and how their research impacted each other's works. To achieve this, we took a look both at a country level and at an author level.

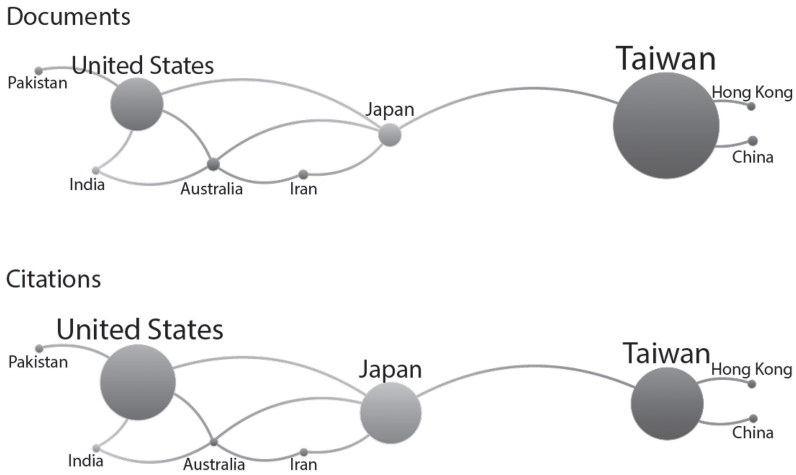
As for countries, when analyzing the co-authorship of the documents, we discovered that, despite Taiwan being the dominant country of origin of this

**Figure 5 Documents by Funding Sponsor**



research, Taiwanese scholars have only coauthored seven articles in conjunction with researchers from abroad: China, Hong Kong, and Japan. The second country, with 16 documents, is the United States, which has links with four other countries: Pakistan, India, Australia, and Japan. In the case of Japan, it has produced its seven documents with four other countries: United States, Australia, Iran and Taiwan. It is interesting to note that Australia, despite publishing only four documents in collaboration with other countries, these have been all different: United States, India, Iran, and Japan. Figure 6 shows the collaboration network of countries, based on co-authorship. Among the 37 different countries where the 125 included documents come from, only nine countries showed collaboration between them, so in this figure we only show these countries, which are grouped in three different clusters: the first one, in red color, includes Taiwan, China and Hong Kong; the second one, in green, comprises Australia, Iran and Japan, while the third cluster, in blue, contains India, Pakistan and the United States. When comparing the number of documents to their corresponding citation counts, it is important to note that the 32 documents from Taiwan received 208 citations, while the 16 documents from the United States received 322 citations, and the seven documents from Japan received 262 citations. This suggest that while Taiwan had the most documents included in the study, the United States had higher citation impact overall, indicating that the latter country has a more significant influence in the field of GBL research. This finding is consistent with previous research by Sezgin et al. (2022), which identified the US as a leading contributor to educational research. Additionally, the observation that Japan received a relative high number of citations despite having fewer documents is consistent with earlier studies that identified Japan as a significant contributor to educational research, particularly in the field of language education (Hou & Yu, 2023).

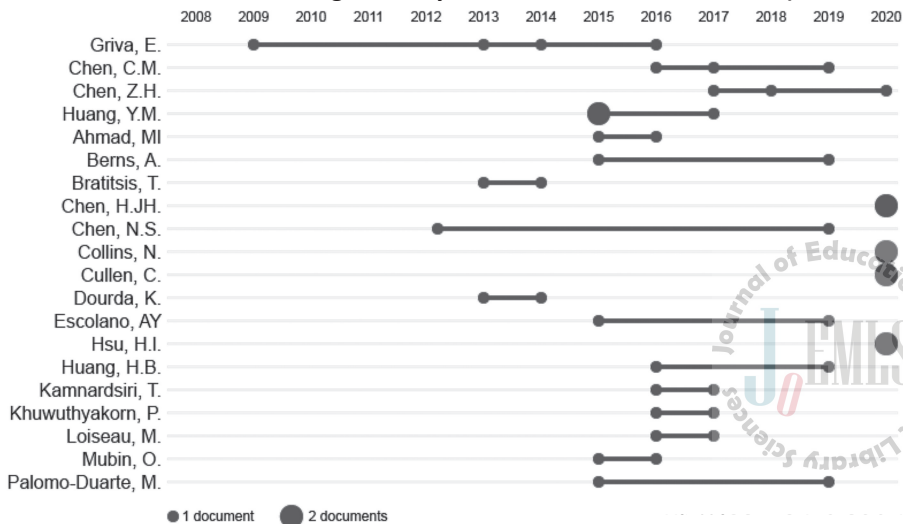
**Figure 6 Co-Authorship Country Network**



Regarding the authors, a total of 340 authors contributed to the 125 documents, with 318 writing multi-authored papers and 22 producing single-authored ones. The author with the most published articles has only four works, and the average number of authors per document is 2.72, indicating a collaborative nature in the research papers, with multiple authors contributing to work. There are no indication of a dominant researcher in the field of game-based learning applied to vocabulary learning.

Given the fact of the relatively low amount of research produced by each scholar, it is important to note how long they have been publishing papers. As we can see in Figure 7 (in which the top 20 researchers are sorted in descending

**Figure 7 Top 20 Authors' Production Over Time (Sorted in Descending Order by Authors' Publication Numbers)**



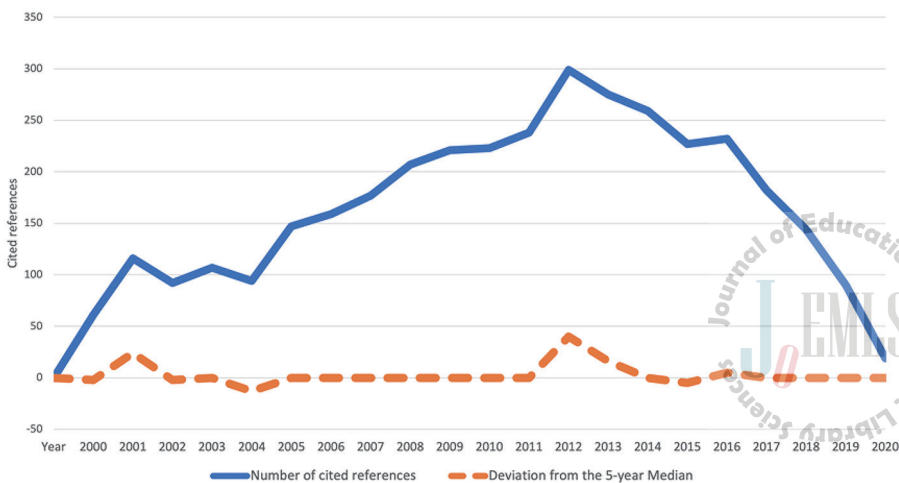




and Google Earth in order to combine GBL with content and language integrated learning, while the other document (Dourda et al., 2014) is a case study about using an online game for content and language integrated learning in a primary school. Manuel Palomo-Duarte, Anke Berns, Andrés Yañez Escolano, and Juan-Manuel Dodero, from the University of Cádiz in Spain, form another group; they have investigated the use of clustering analysis (Palomo-Duarte et al., 2019) and data mining (Palomo-Duarte et al., 2015). Another group includes Teerawat Kamnardsiri, Ler-on Hongsit, Pattaraporn Khuwuthyakorn, and Noppon Wongta, from Chiang Mai University in Thailand; they worked together on two studies in which they have used Kinect for learning sign language (Kamnardsiri et al., 2016, 2017). Finally, Naoise Collins, Brian Vaughan, and Charlie Cullen, from the Technological University Dublin in Ireland, integrate another relevant group; they investigated the use of situated immersive games (with Unity and Oculus Rift for virtual reality settings) for improving motivation in Irish language learning (Collins et al., 2020). Apart from other four pairs of researchers, the rest of scholars have worked individually. In general, we can see that collaboration between colleagues from the same institutions tend to focus on constant topics.

The documents consulted by the researchers can give us an idea of how the knowledge has been shared, so we analyzed the 4,268 valid references found among the 125 included papers. Figure 9 presents a visualization of the referenced publications that have had the most impact in the included documents. As we can see, there are two visible peaks in the 5-year-median: one in 2001 and the other one in 2012. Regarding 2001, the two documents with the most impact are the one by Prensky (2001) which pioneered the study of the then new field of digital game-based learning, and the one by Nation (2001), a

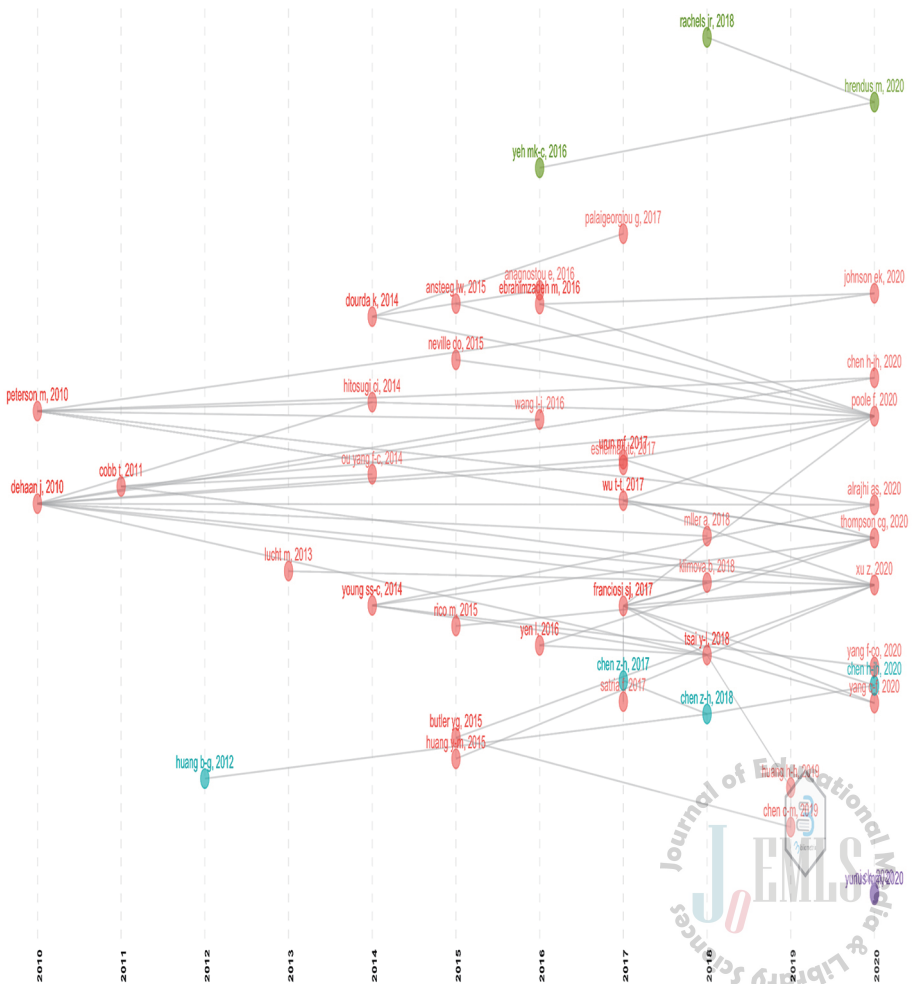
**Figure 9 Cited References Years 2000-2020**



comprehensive study in vocabulary learning; each of this two books were cited 12 times (which account for 10.38% each one of the 116 cited references of 2001). Regarding 2012, the most notable authors are Peterson (2012), whose exploratory sociocultural analysis on learner interaction in a massively multiplayer online role playing game was cited in 11 studies, or 3.68% of the 299 references in 2012; Chiu et al. (2012), Reinders (2012), and Rama et al. (2012); each of these three documents were cited eight times, or 2.68% of the 299 references of 2012. Since that year, the number of cited references has been constantly decreasing to the mere 19 documents in 2020.

As for direct citations, Figure 10 shows the historical evolution of the 50 documents that have the most impact in this field. This historiograph shows

**Figure 10 Top 50 Documents' Historical Direct Citation Network**

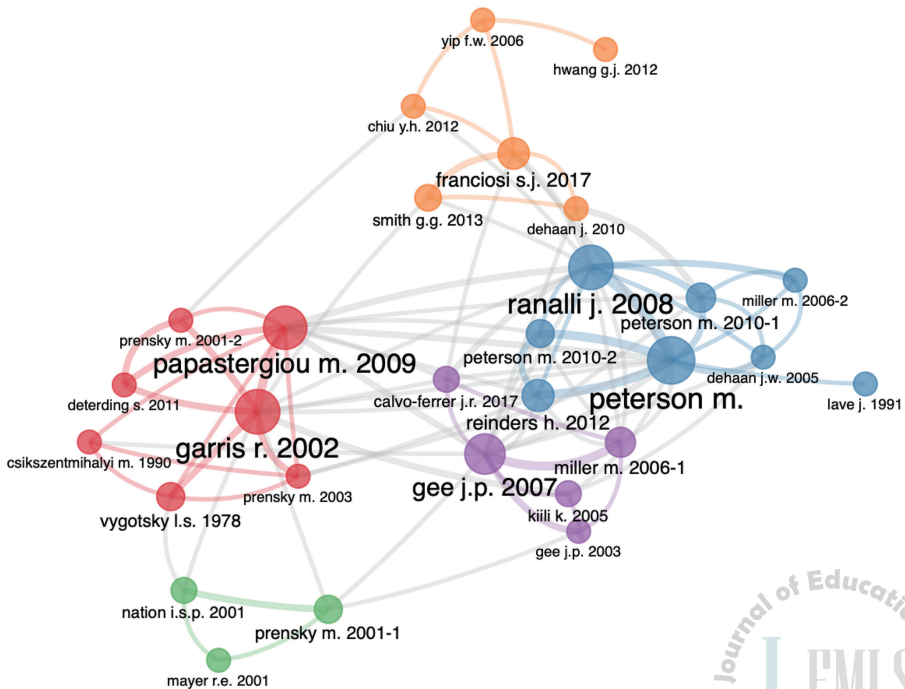


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a progression in how much authors have been cited within GBL regarding vocabulary learning. Among these authors, Deehan (2010) is not only one of the oldest, but also the one who is most cited, with 10 local citations (within this specific topic) and 107 global citations (i.e., cited for other fields). The second one is Franciosi (2017), with eight local citations and 35 global citations. However, Peterson (2010), although has been locally cited only six times, has 82 global citations, meaning his influence has reached beyond GBL and vocabulary acquisition.

Regarding the intellectual base of research, Figure 11 shows the co-citation network of the studies that have been cited together. We can see five clusters, where the node sizes are proportional to the number of citations and the lines connecting them indicate that those documents have been cited together. Cluster #1 (in red) includes seven documents, among them the oldest ones in this set and focusing more towards pedagogy, while Cluster #2 (in blue, with eight documents) and Cluster #5 (in orange, with six documents) deal with topics more related to game-based learning.

**Figure 11 Co-Citation Network by Papers**



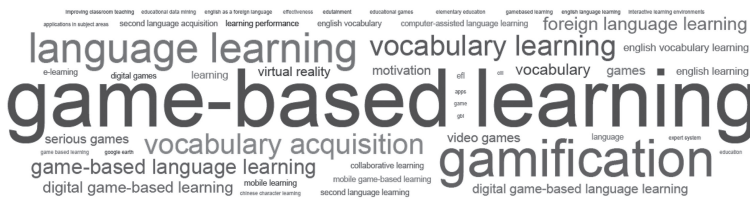
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### Conceptual Structure of Research

In order to answer RQ3, we started by counting the keywords listed in the articles; the results yielded 395 author’s keywords and 378 keywords plus. According to J. Zhang et al. (2016), although keywords plus are comparable to author keywords for bibliometric analysis, there are less comprehensive regarding the articles’ content; for this reason, the analysis will henceforth be based on author keywords. Figure 12 visualizes the 50 most numerous author keywords in the form of a word cloud, proportionally to their frequency. As we can see, the most relevant keywords are “game-based learning” (31 occurrences), “gamification” (20), “language learning” (16), “vocabulary acquisition” (11), and “vocabulary learning” (11 occurrences). It is important to note that, in addition to the 31 occurrences of “game-based learning”, there are also two occurrences each for “game based learning” (*sic*), “gamebased learning” (*sic*), and “gbl” which, although refer to the same concept, are spelled differently.

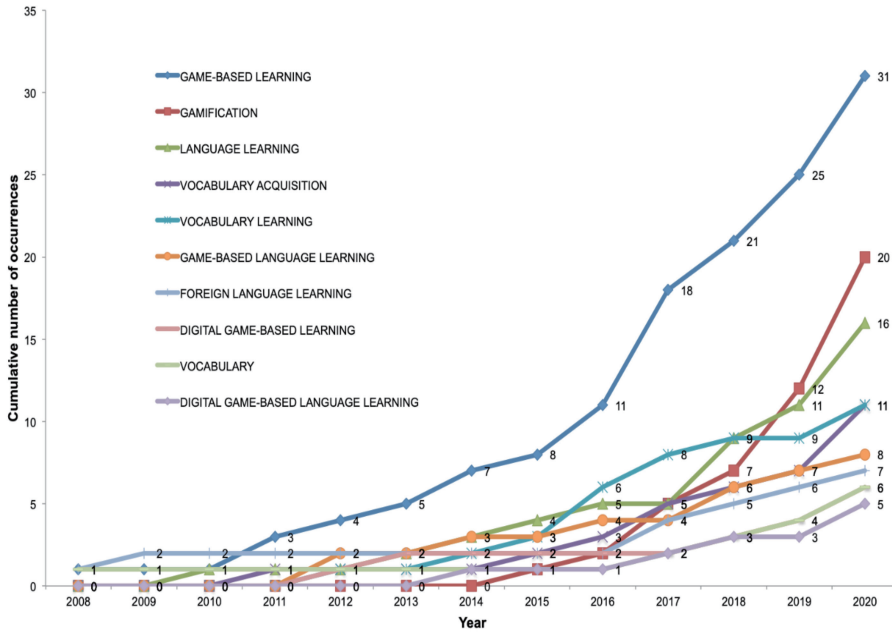
**Figure 12 Word Cloud of Keywords’ Occurrences**



Furthermore, these keywords have evolved differently over the years. Figure 13 presents the keyword dynamics; “game-based learning” has had a constant growth and since the last decade surpassed the other topics, while “gamification” has accelerated since 2018, as well as “language learning” since 2017. It is important to note that “vocabulary acquisition” has matched “vocabulary learning” recently. Although both terms can be considered synonyms, experts like Zaščerinska (2010) and Shaul (2014) explain that acquiring a language is a subconscious and meaningful process, while learning a language is a conscious and more structured method.

A closer look at the author keywords can give a clearer image of the topics that have attracted the most. Out of the 338 author keywords that have appeared at least twice in these studies, “game-based learning” has 31 occurrences (9.17%), “gamification” has 20 occurrences (5.91%), and “language learning” 16 occurrences (2.71%). It is important to note that some of these keywords could be considered synonyms, depending of the definition (like “vocabulary learning” and “vocabulary acquisition”) or some of them can be considered as more specific subtopics of others (like “foreign language learning” being part of a more general “language learning”).

**Figure 13 Keyword Growth**



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In order to further understand the evolution of the topical trends, we grouped the keywords into five-year time spans. As the first published papers from 2001 to 2020 appeared in 2008, the first period, from 2001 to 2005 didn't have any papers, so here we present three periods: 2006-2010, 2011-2015, and 2016-2020. Table 1 presents these periods in respective columns, as well as the combined evolution of keyword co-appearance from 2006 to 2020; the top 10 keywords of each year group are shown.

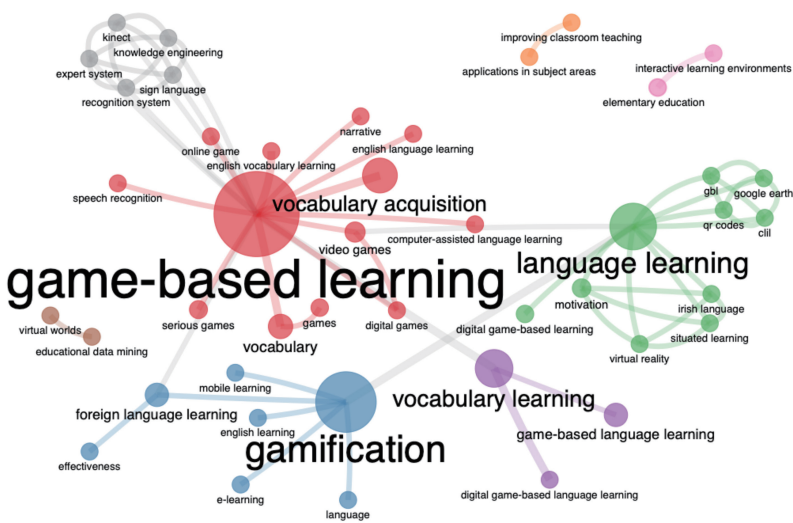
During the first phase, from 2006 to 2010, only seven papers were published; during this time the keywords defined by the authors had a very low occurrence count, mostly only once each. During the 2011-2015-time span, the number of published papers increased to 29. However, except for the keyword "game-based learning" that has seven occurrences and was cited by 58 papers, the rest of the keywords continue to have a minimum occurrence count. The situation changes during the final analyzed period, from 2016 to 2020. The bulk of the papers (totaling 89) were published during this phase, and the different topics have a more robust occurrences count. Regarding the overall total from 2006 to 2020, it is important to note how the term "game-based learning" has been the most stated in the last decade. Additionally, the big amount of papers during the last five years has a tremendous impact on the overall account.

**Table 1 Trend Evolution in Keyword Co-Appearing**

2006-2010		2011-2015		2016-2020		Total 2006-2020	
Keyword	<i>n</i>	Keyword	<i>n</i>	Keyword	<i>n</i>	Keyword	<i>n</i> Cited by
foreign language learning	2	game-based learning	7	game-based learning	23	game-based learning	31 141
game-based tutoring system	1	action research	1	gamification	19	gamification	20 25
language learning	1	adolescence	1	language learning	12	language learning	16 50
learning performance	1	attitude	1	vocabulary acquisition	9	vocabulary learning	11 139
listening	1	case study	1	vocabulary learning	8	vocabulary acquisition	11 68
revision	1	college / university students	1	vocabulary	5	vocabulary	6 10
translation	1	context clues	1	foreign language learning	5	foreign language learning	7 56
effectiveness	1	extrinsic	1	video games	4	game-based language learning	8 19
game-based activities	1	general vocabulary	1	games	4	video games	5 17
game-based learning	1	information and communication technologies	1	game-based language learning	5	serious games	5 27

How much different author keywords appear together in the same studies allows understanding the relations between topics. A co-occurrence network analysis resulted in the 338 author keywords grouped into 33 clusters, with a total of 1,087 links between them. The biggest cluster includes 19 keywords, while the smallest comprises three items. Figure 14 shows the top 40 keywords in different colors according to the eight main clusters, and also with node size variation, in relation to their occurrences' weight. Furthermore, it is evident that "game-based learning", "gamification", "language learning", and "vocabulary acquisition" present more density than the others. The most important keyword is "game-based learning", with 31 occurrences and 113 links to other keywords; it is followed by "gamification" with 80 links, "language learning" (49 links), "vocabulary learning" (46 links), and "vocabulary acquisition" (43 links). It is important to note that keywords addressing either games or languages tend to occur together more (red, blue, green and purple clusters) than keywords related to other topics (gray, orange, brown and pink clusters).

For example, the red cluster is dominated by the keyword "game-based learning", and the most cited paper with this keyword also includes the keywords "computer-assisted language learning"; "corpus-based learning"; "data-driven learning"; "research-based instruction"; and "vocabulary acquisition", and consist in a Canadian study that uses a suite of games designed for Nintendo in a Francophone English environment (Cobb & Horst, 2011). In the blue cluster, the most cited document that includes the keyword "gamification" also

**Figure 14 Author Keywords Co-Occurrences Network**

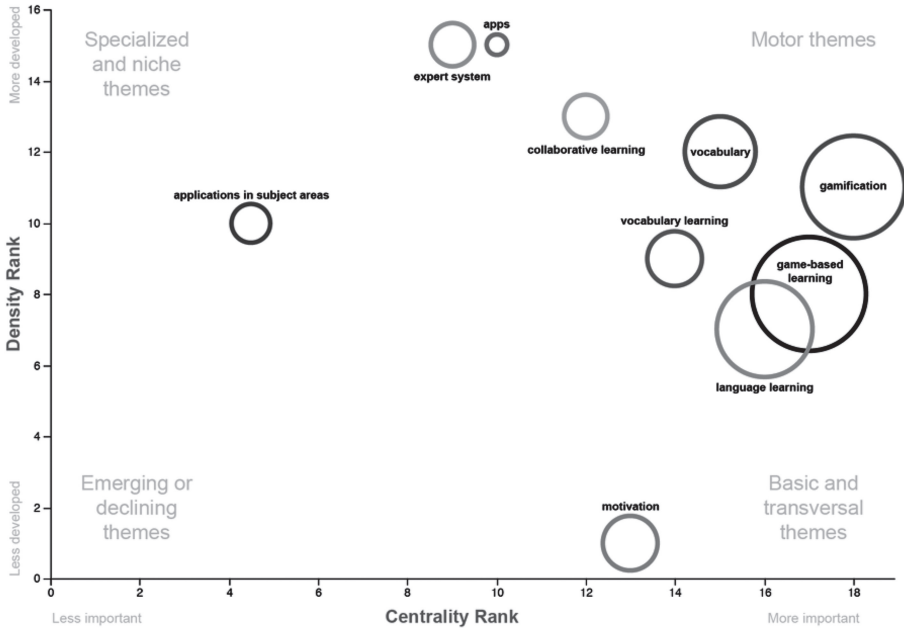
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contains the keywords “serious video-games”, “digital game-based learning”, and “language learning”, and it is a theoretical article that discusses principles and applications for video games in foreign language learning (Casañ Pitarch, 2018). The green cluster revolves around language learning and its relation with different technologies, like virtual reality, QR codes, Google Earth, etc., as well as factors like motivation or situated learning. A good example is the article published by Dourda et al. (2014), which includes the keywords “CLIL”; “GBL”; “Google Earth”; “language learning”; and “QR codes” and consists in integrating QR codes and Google Earth for English learning in Greek primary schools.

Figure 15 shows a thematic map that groups the keywords found in this study into clusters or themes, and organizes these themes according to their centrality and density. Centrality refers to how relevant or essential they are considered by the research community, while density reflects how developed, coherent, and stable they are due to the internal ties between diagram, with the size of each cluster based on the number of keyword occurrences. The results show that many of the clusters are relevant themes that fall either in the category of motor themes (well-developed and important themes), or basic and transversal themes (important because of the relations to other external themes, but not very developed because they lack more internal links); all the top half of the clusters fall under these two categories. The first cluster, labeled “game-based learning”, also includes the keywords vocabulary acquisition, English vocabulary learning, computer-assisted language learning, learning performance, second language learning, English language learning, mobile learning game, narrative,



Figure 15 Thematic Evolution Map



online game, primary schools, and speech recognition. The next cluster, labeled “gamification”, also includes the words foreign language learning, English learning, e-learning, efl, language, mobile learning, education, effectiveness, game based learning, memory, teaching, and ubiquitous learning. The third cluster, labeled “language learning”, also includes the keywords digital game-based learning, video games, digital games, English vocabulary, second language acquisition, CLIL, educational games, game, GBL, Google Earth, and QR codes. These three clusters can be considered the motor themes among the documents included in this study: they are both well developed and also considered more important by researchers, along with the themes “vocabulary” (which also includes the keywords games, serious games, learning, educational data mining, orthography, and virtual worlds) and “vocabulary learning” (also including the words game-based language learning, digital game-based language learning, and English as a foreign language). The cluster “application in subject areas” is considered a specialized theme because, despite being developed, it is not considered important; this cluster also includes keywords related to elementary education, improving classroom teaching, and interactive environments. These topics make this cluster rather niche.

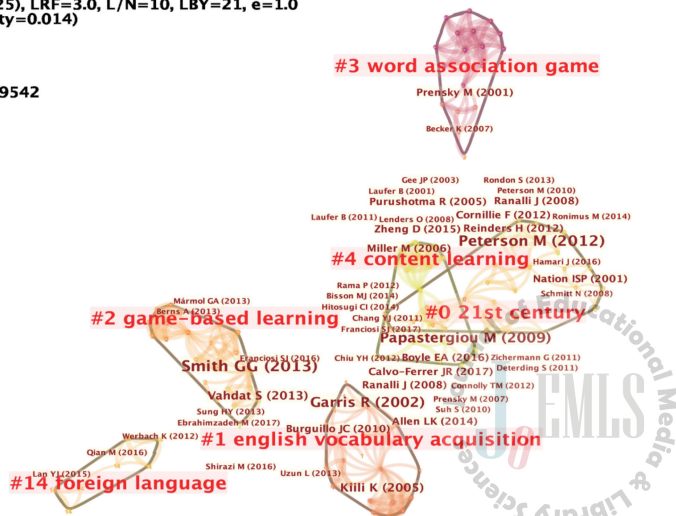
It is interesting to note that the topic of “motivation” has a very low degree of development, which diverge with recent research regarding the positive relation between the broader topic of language learning and gaming (X. Chen,

Hao, et al., 2018; Chiu et al., 2012; Tsai & Tsai, 2018). This cluster has not been well-developed, and it only includes the keywords related to “motivation”, “virtual reality”, “edutainment”, “Irish language”, and “situated learning”.

An analysis and visualization of trends and patterns shown in Figure 16 allows identifying the main clusters. The network is divided into six co-citation clusters. The largest cluster (#0) has 30 members and a silhouette value of 0.923. It is labeled as “21st century” by both LLR and LSI, and as “gaming level” (1.02) by MI. The most relevant citer to the cluster is Chen et al. (2020). The second largest cluster (#1) has 25 members and a silhouette value of 0.944. It is labeled as “English vocabulary acquisition” by LLR, “call system” by LSI, and “portfolio analysis” (0.7) by MI. The most relevant citers to the cluster are Young and Wang (2014), which performed a study that developed a game-embedded computer-assisted language learning system, integrating game strategies with automatic speech recognition for learning English (Young & Wang, 2014). The top ranked item by citation counts is Smith (2013) in Cluster #2, with citation counts of eight. The second one is Peterson (2012) in Cluster #0, with citation counts of seven. The third is Papastergiou (2009) in Cluster #0, with citation counts of six. The 4th is Garris (2002) in Cluster #1, with citation counts of six. The 5th is Vahdat (2013) in Cluster #2, with citation counts of four. The 6th is Kiili (2005) in Cluster #1, with citation counts of four. The 7th is Allen (2014) in Cluster #1, with citation counts of three. The 8th is Nation (2001) in Cluster #0, with citation counts of

Figure 16 Keyword Clusters and Authors

CiteSpace, v. 5.8.R3 (64-bit)  
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 Scopus: /Users/julioareck/Desktop/citespace 125/output  
 Timespan: 2008–2020 (Slice Length=1)  
 Selection Criteria: g-index (k=25), LRF=3.0, L/N=10, LBY=21, e=1.0  
 Network: N=366, E=933 (Density=0.014)  
 Largest CC: 119 (32%)  
 Nodes Labeled: 1.0%  
 Pruning: None  
 Modularity Q=0.9199  
 Weighted Mean Silhouette S=0.9542  
 Harmonic Mean(Q, S)=0.9367



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three. The 9th is Burguillo (2010) in Cluster #1, with citation counts of three. The 10th is Purushotma (2005) in Cluster #4, with citation counts of three. It is interesting to note that only Clusters #0 and #4 intersect, while the rest remain independent.

### **Conclusions: Summary, Implications and Future Trends**

The present study has utilized quantitative methods to analyze the trends in games and vocabulary learning over two decades. The research conclusions are divided into three areas; geographic localization and distribution of research studies, intellectual and social structure of research, and conceptual structure of research.

Regarding the volume and distribution by geographic source of research, the number of papers on this topic has been steadily increasing over the years, and Taiwan has been found to be the most prolific source of research, accounting for one out of every four documents analyzed. It is clear that Taiwan is, with 32 out of 125 published studies, the most prolific source of research by far, doubling its following source, the United States, with 16 documents included in this study. This is further reflected in the fact that Taiwanese universities concentrate the bulk of the research in the topic. Moreover, the institutions that have sponsored the most articles are also Taiwanese. This suggests Taiwan is positioned itself as an important source of research in GBL applied to vocabulary learning, distinguishing this particular field within GBL in general, where the United States dominates the quantity of research. Although research on game-based learning applied to vocabulary learning has been performed in Asia, Europe and North America, Taiwan has a clear advantage over the rest of the countries producing research on this field: one out of four documents were originated in Taiwan. The reason of this can be related to the current “Bilingual Nation 2030” policy that drives the increase of learning English in Taiwan (NDC, 2021). As game-based learning has proven to have a positive effect on short-term and long-term vocabulary learning (Zou et al., 2021), it is not surprising to see an increase in research regarding GBL on vocabulary learning in Taiwan. The implication of these results is that researchers can benefit from the cumulative research in the leading countries like Taiwan and the United States, as well as considering these countries for future research projects and collaborations.

Regarding the intellectual and social structure, the results of this study show researchers have been grouped in few clusters, organized according to the topical trends we have identified, and working regularly with the same coworkers when they co-author papers. The study also shows that researchers tend to work with the same colleagues and institutions, which indicates a rather low level of collaboration between different institutions and countries. This could be

attributed to the localized projects that respond to specific situations, or to the convenience of working with trusted partners. The results obtained suggest a wide variety of authorship in the field, with no dominant authors creating clear schools of thought. Furthermore, the most cited external authors were Prensky (2001) and Peterson (2012) in the included documents. Besides, the results also suggest that there are no dominant institution leading the research in the field, but also that there is a rather modest amount of cooperation between both institutions and scholars to perform research on the topic. Authors tend to work regularly with the same colleagues from within the same institutions, notably at the University of Western Macedonia, the University of Cádiz, Chiang Mai University, and the Technological University Dublin; most other scholars tend to work in pairs or individually. The results have implications for researchers and institutions. Researchers should be aware of the low level of collaboration between scholars from different institutions and strive to collaborate with colleagues from different backgrounds and institutions. Institutions can encourage collaboration among their researchers by creating culture that value interdisciplinary research and rewards collaboration. They can also establish partnerships with other institutions to encourage collaboration between researchers, such as joint research project, exchange projects, and joint publications. Finally, institutions can foster diversity and inclusion by recruiting researchers from different backgrounds and cultures, which can encourage collaboration between researchers from different institutions and countries.

In terms of the conceptual structure, we analyzed the topics that have received the most attention from scholars. Four clusters were defined in recent years, with topics focused on “game-based learning”, “gamification”, “language learning” and “vocabulary learning”. Additionally, the analysis of the author keywords indicated that the topics being studied have been evolving and diversifying over time. However, the literature indicated that motivation and engagement, which have been highlighted as important factors in recent papers on the relationship between game-based learning and language learning (M.-H. Chen, Tseng, et al., 2018; Chiu et al., 2012; Tsai & Tsai, 2018; Peterson, 2013), were not a major focus in the studies analyzed, with the keyword “motivation” appearing only five times. The researcher also found that English was most studied language, which is not surprising given that a quarter of the included studies were from Taiwan, where there is a bilingual policy in place and English is taught as a second language. However, they pointed out that recent studies have highlighted the importance of motivation and engagement in game-based learning and language learning, and this presents an opportunity for future research to explore how motivation impacts vocabulary learning specifically.

Overall, the researchers identified game-based learning and gamification as the main themes that have attracted attention from researchers, with authors open to using games specifically designed for learning objectives, as well as game mechanics or tools to enhance the learning experience. They noted that both co-occurrence and thematic analyses revealed a focus on integrating different gaming strategies and technologies (online games, video games, virtual reality, motion sensing, etc.) in vocabulary acquisition. The study also revealed a consolidation of topics over time, suggesting a growing consensus on the terminology used in the field and a more mature literature on game-based learning. The researchers highlighted the importance of identifying key producers of research and examining collaboration networks between research topics and how they have evolved over time. In a word, the findings of this study provide useful insights into the current research trends in the field of games and vocabulary learning.

The study also highlighted the relatively low focus on motivation and engagement, presenting an opportunity for future researchers to explore the impact of motivation on game-based learning specifically in vocabulary acquisition. The study predicts that the research on games applied to vocabulary learning will continue to increase, and future studies will determine whether gamification will be more developed and considered more important than game-based learning.

In summary, the study identified the key producers of research in the field (Taiwan and the United States), examined the collaboration network between researchers, and analyzed the most important research topics (“game-based learning”, “gamification”, “language learning” and “vocabulary learning”) in games and vocabulary learning. The study provides insights into current research trends and highlights opportunities for future research, such as exploring the impact of policies, promoting collaboration, and investigating the role of motivation in game-based learning.

### **Limitations**

This study presents some constraints and caveats: the results of our research depend on the data source, which in this case is Scopus; this may present some inconsistencies with other databases or it may miss some documents that could have otherwise been included in the present paper. Moreover, as the information is dynamic and can change over time (this is especially true regarding citations, that increase over time), our results only represent the data available at the time of our research. Another limitation we faced is the variety of terminology related to game-based learning: terms as

“gamification”, “serious games”, “edutainment”, etc., that the authors define as research keywords in their papers may have affected the documents included in our study. Additionally, we also found inconsistencies in the way different papers state information regarding names of institutions, countries, etc., which makes bibliometric analysis difficult. Finally, as mentioned in the Method section, some inconsistencies in the results yielded were found among the different software used for data analysis, a limitation of the software versions available at the time of research.

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# 應用遊戲化於詞彙學習： 二十年研究文獻書目計量分析之研究

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## 摘要

近年來數位遊戲的出現對不同教育領域產生影響，尤其遊戲對語言學習的學習動機與參與產生正向影響。本研究旨在從地理區域、研究知識及社會、概念結構來分析遊戲式學習和遊戲化學習於詞彙學習之最新研究趨勢。本研究篩選125篇在2000年至2020年間所發表的文獻來進行書目計量分析；主要研究結果發現四分之一的遊戲化和詞彙學習相關研究是在台灣進行，美國緊隨其後；然而，研究機構和國家之間的合作卻相當少。本研究結果亦確定主題領域最有影響力之研究人員及其他之間的合作關係。另，在這20年間「遊戲化」、「遊戲式學習」、「語言學習」、「詞彙」、「詞彙學習」和「協作學習」這些主題是相當被研究者所關注的。最後，本研究亦依據出版趨勢和尚未被關注相關議題為未來相關研究提出建議。

**關鍵詞：**書目計量分析，遊戲式學習，遊戲化，詞彙學習

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