



Gamification in education: A scientometric, content and co-occurrence analysis of systematic review and meta-analysis articles

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Abstract

This study seeks scientometric, content and co-occurrence analysis of systematic review and Meta-analysis articles in the field of gamification in education. In terms of *purpose*, this is an applied study and regarding *type*, it is a scientometric and co-occurrence analysis. The researchers conducted a search in WoS, Scopus and PubMed databases. The abstract and full text of 25 out of 71 articles were selected to be included in the study. Then, the citation and altmetrics indicators were investigated. In addition, VOSviewer software was utilized to analyze and visualize keywords and map of articles. Finally, the full texts of all articles were analyzed to be provided more information about the types of analyses in these articles. The findings showed that 25 articles were published between 2016 and 2021. Co-occurrence map of articles showed that the three variables of motivation, learning, and engagement have been considered in gamified education studies and most studies have examined gamification in the e-learning environment. Finally, the content analysis of the articles showed that 344 articles were included and analyzed in these 25 systematic reviews and meta-analyses. The types of analyzes performed on these 344 articles categorized them in 7 categories including Country/Territory, Duration of intervention, Lessons/content and the level of gamified educational course, the number of learners, platforms, the game elements and the theories. The results of the study illustrate that different dimensions of the gamification in articles in the field of Education have been considered by the researchers.

Keywords Gamification · Education · Content analysis · Co-occurrence analysis

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1 Introduction

In the current age, computer games are one of the things that digital culture has brought to modern life. The latest concept in this field is termed gamification, which acts as a broad umbrella for the use of video game components in order to improve the experience and increase users' participation in environments and contexts that are not related to the game (Hamari et al., 2014).

Gamification, which is related to the field of digital media industry (Schönen, 2014), means "the use of game design elements in non-gaming spaces" (Deterding et al., 2011). In fact, gamification is the use of tools and mechanism, aesthetic aspects and game thinking to make people more engaged and motivated to behave specifically, and encourage them to learn and solve problems (Kapp, 2012). Now, it covers a very wide and diverse range such as education and learning, health, e-commerce, environment, and hotel management (Deterding et al., 2011). Thus, gamification is the use of game-like thinking and characteristics in areas that are not inherent in the game (Huotari & Hamari, 2012); however, it uses game structures such as foundations, stimuli and components of game to solve life problems (Chou, 2016).

The word gamification was coined in 2002, but the concept first became popular in the scientific literature in the second half of 2010, and gained popularity among researchers in 2011. Gartner predicted that by the end of 2015, more than 40% of the world's top 1,000 organizations will benefit from gamification components in terms of customer orientation and product quality improvement (Schönen, 2014) and in the near future, there will be significant progress in the field of internalization of internal processes as well as external interactions, i.e. attracting more users and customers (Burke, 2012). Currently, there are a lot of websites and experts in this field and many articles have been written on this topic and its sub-categories. This generated knowledge can inherently provide valuable information about the role of gamification in various aspects of life. A simple Google search for new teaching and learning methods shows that gamification is a fascinating method alongside other methods such as flipped learning, project-based learning, cooperative learning, problem-based learning, design thinking, thinking-based learning, and competency-based learning (Real-influencers, 2019). Interestingly, this method itself has the ability to be integrated with other methods so that, an inverted learning method, for instance, can be linked to a collaborative learning using gamification. Discovering and using this information in the field of learning and teaching requires a look through the literature in this field. Systematic review and meta-analysis articles are most probably the best, shortest and fastest ways to obtain valid information in this regard. These types of articles aim to evaluate, select, and synthesize quality studies in a specific field to provide more accurate results, which can not only provide high-quality evidence but also make decisions about reviewing original studies easier and faster. On the other hand, the results of the research by Hamri, Quisto and Sarsa testify to the claim that the most widely used concept of gamification has been in the field of "teaching and learning" (Hamari et al., 2014). Therefore, an analysis of systematic review and meta-analysis articles in this subject area can provide valuable information for researchers and those interested in the status of studies related to the gamification in the field of education.

In addition, altmetric analysis of high-quality articles in a subject area contributes to our greater knowledge of research, topics, and trends. This type of analysis shows the process of dissemination, the evolution of knowledge and the evidence-based practice of a subject. Therefore, due to the increasing applications of scientometrics in the evaluation and measurement of scientific products, the purpose of this study is scientometric analysis of the systematic review and meta-analysis articles related to gamification (Mostafavi & Bazrafshan, 2011). Examination of citation and altmetric indices of articles shows their scientific and social impact (Lora et al., 2020).

Co-occurrence analysis is also one of the types of scientometric analysis namely content analysis, which is obtained through the co-occurrence of words with the concepts in texts and sources, which can be used to identify the main concepts of a field or scientific field. As a result, patterns and conceptual events, scientific structure, conceptual network, hierarchical relationships of concepts and conceptual categories of the field under study are discovered, plotted and managed (Zhang et al., 2016). This conceptual network is drawn by counting the number of thematic words in the text and its association with other topics. In other words, if two terms are used together in a document and are repeated as much as possible, it means that these two words are more semantically related. The co-occurrence of two terms or two words is also used to discover the connection between two topics in a field of research, and in this way the development and progress of that field of science can be traced (Ahmadi & Osareh, 2017). Among the studies that have dealt with the co-occurrence of words in the scientific productions of different subject areas are Covid-19 (Al-Zaman, 2021), Coronavirus (Atlasi et al., 2021), Artificial Intelligence (Chen et al., 2020), Dentistry (Ghaffari et al., 2019), Diabetes (Makizadeh et al., 2016), Blockchain technology (Niknejad et al., 2021), Child abuse (Tran et al., 2018). Therefore, considering that the use of gamification in education has caught many researchers' attention and numerous systematic review and meta-analysis studies has been done in this regard, this study seeks scientometric, content and co-occurrence analysis of systematic review and meta-analysis articles in the field of gamification in education.

2 Method

The purpose of this study is a scientometric, content and co-occurrence analysis of systematic review and meta-analysis articles in the field of gamification in education. In terms of purpose, this is an applied study and regarding type, it is a scientometric and co-occurrence analysis.

2.1 Literature search strategy

In order to retrieve systematic review and meta-analysis articles related to gamification, using related keywords (Systematic review, meta-analysis, Game, Games, Gamification, Gameful), a search was conducted in WoS, Scopus and PubMed databases. Education-related keywords were not added to the search strategy, and after

reviewing the titles and abstracts of the articles, articles in the field of education were selected.

2.2 Inclusion and exclusion criteria

Inclusion criteria Articles of systematic review and meta-analysis in the field of Gamification in Education.

Exclusion criteria Articles which were not based on the definition of gamification (Deterding et al., 2011; Kapp, 2012; Nicholson, 2015) (using game elements in non-game environments to change behavior and solve problems) and were not related to the use of Gamification in Education.

2.3 Identification, selection, and coding

In the identification phase, 421 articles were retrieved with our search strategy. After removing duplicates, 208 articles remained for further review. Afterwards, the articles were screened, out of which 71 articles were selected. Finally, the abstract and full text of selected articles were reviewed and only 25 articles (based on inclusion and exclusion criteria) selected to be included in the study. Figure 1 shows the flowchart of the present study process.

2.4 Data analysis

2.4.1 Citation and Altmetric analysis

In order to investigate the scientific and social impact of the articles, their citation and altmetrics indices were extracted from WoS and Scopus. Citation indicators such as WOS and Scopus Citation, the scientific impact of articles and altmetrics indicators such as Mendeley Read, Facebook Share, Tweets, Scopus View, WOS Usage Count Since 2013, and Altmetric Attention Score, show their social impact.

2.4.2 Co-occurrence analyses

Finally, using VOS viewer software, the word map of articles was drawn. The mapping of a scientific field is a technique that provides a structured overview of the science. One of the techniques used to map science is the visualization of similarities (VOS). By drawing a graphic of each discipline, science maps have paved the way for a better and more accurate identification of that branch of human knowledge and the transformation of the abstract concept of the discipline into a more objective concept. These maps are drawn with various

techniques and methods. One of the purposes and applications of co-occurrence analysis is to draw the structure of science or to draw scientific maps. In a keyword co-occurrence map, the size of the circles shows the number of repetitions of the keywords. In other words, the larger the circle, the more frequent the vocabulary of that domain. In a keyword co-occurrence map analysis, the relative distance of one concept to another is emphasized. The proximity of keywords at the point means that more concepts are related to each other. In addition, the thicker and shorter the lines are, the stronger the connection between the words exists.

2.4.3 Content analysis

In order to analyze the content of the articles, the following items were extracted from 25 reviewed articles: Subject, Number of articles reviewed in each article, Names of databases searched in 25 articles for resource extraction (ERIC, Science Direct, ACM Digital Library, IEEE Xplore, Scopus, Springer Link, Wiley Online Library, Google Scholar), Extraction period of resources reviewed in 25 articles, Language of resources reviewed in 25 articles (English, Spanish, etc.), and type of publication reviewed in 25 articles (journal article, conference article, dissertation, book).

3 Results

3.1 Citation and Altmetric analysis

In this study, 25 systematic reviews (18 articles) and meta-analyses (seven articles) in the field of gamified educational environments were studied. All articles were published between 2016 and 2021 that 6 articles were conference proceedings and the others were journal articles. Table 1 shows the findings of top articles regarding the altmetric and citation indicators.

It can be seen from Table 1, in terms of the number of *citations* and *views* in WoS and Scopus and the number of *read* in Mendeley, the article by Subhash & Cudney (2018) is the best one among all articles. The highest number of *FWCI* belongs to the article by Kalogiannakis et al. (2021).

3.2 Co-occurrence analyses

Next, the co-occurrence map was comprised of 64 keywords from authors and database keywords by using VOSviewer software, which is shown in Fig. 2. The size of the circles indicates the amount of knowledge available in each concept. Nodes represent concepts and lines show how they are related.

Figure 2 shows that *gamification* keyword is at the center of the map. The keywords *Motivation*, *student learning*, *computer aided instruction*, *engagement*,

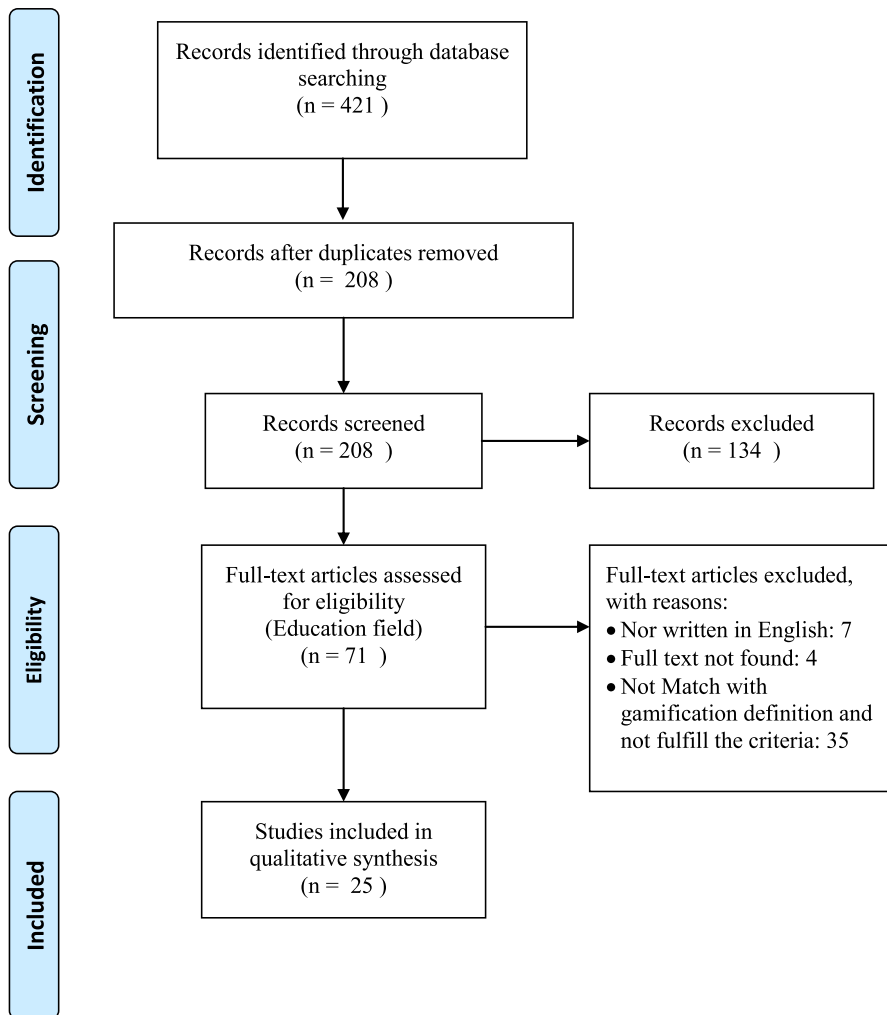


Fig. 1 Flowchart of present study process

learning achievement, learning performance are also keywords that have a larger node. Figures 3, 4, 5 and 6 highlights the relationship between the four most frequent keywords with other keywords.

As can be seen from the maps (3-6), the three variables, including motivation, learning, and engagement have been considered in gamified education studies. It is also clear that most studies have examined gamification in the e-learning environment.

3.3 Content analysis

In the next step, the full texts of all 25 articles were examined and information such as databases, period, language, type of included resources (conference article, journal article, thesis and book) and the number of included articles were extracted. Table 2 shows that the included articles in these 25 systematic reviews and meta-analyses were indexed in 48 databases, the most repeated one belongs to *WoS* with 12 cases and *ERIC*, *Science Direct*, *ACM Digital Library*, *IEEE Xplore*, *Scopus*, *Springer Link*, *Wiley Online Library*, *Google Scholar* are in the next ranks. In addition, the most and least number of articles in these 25 studies are 148 and 6 cases, in turn. Most of the which are in *English*. However, there were some articles in *Dutch*, *Portuguese* and *Spanish* in some studies.

In 25 systematic reviews and meta-analysis articles, 344 articles were included and analyzed. Having read the full text of all 25 articles, the researchers extracted the types of analyzes performed on these 344 articles and categorized them in 7 categories including:

1. Country/Territory related to studies in the field of gamified education studies
2. Duration of intervention
3. Lessons/content and the level of gamified educational course
4. The number of learners
5. The used platforms
6. The game elements
7. The used theories in the studies

3.4 Country/territory

Cultural differences can create different expectations and attitudes in learners about gamified learning in different countries. Table 3 shows that only 11 out of 25 studied articles reported country/territory where intervention was conducted.

As it is clear from Table 3, most of the studies in the field of gamified education were conducted in the US, Canada and Spain, respectively.

3.5 Duration of gamified educational intervention

One of the most important items in the field of gamified education considered by researchers is course effectiveness based on the length of the intervention. Table 4 shows that only in 8 studies, the duration of gamified intervention were reported.

Table 4 indicates that the maximum and minimum lengths of each course are "less than one hour" and "one to two years", in turn.

Table 1 Top articles in terms of citation and altmetric metrics

Metrics	No. Of Metrics	Author	Title	Year	Journal
WoS Citation	104	Subhash & Cudney, 2018	Gamified learning in higher education: A systematic review of the literature	2018	Computers in Human Behavior
Scopus Citation	142				
Scopus View	522				
Usage Count Since 2013	202				
Mendeley Read	835				
FWCI	33.57	Kalogiannakis et al., 2021	Gamification in science education. A systematic review of the literature	2021	Education Sciences
Facebook share & Tweets	413	Osatuyi, Osatuyi et al., 2018	Systematic review of gamification research in IS education: A multi-method approach	2018	Communications of the Association for Information Systems
AAS		Sailer & Homner, 2020	The Gamification of Learning: a Meta-analysis	2020	Educational Psychology Review

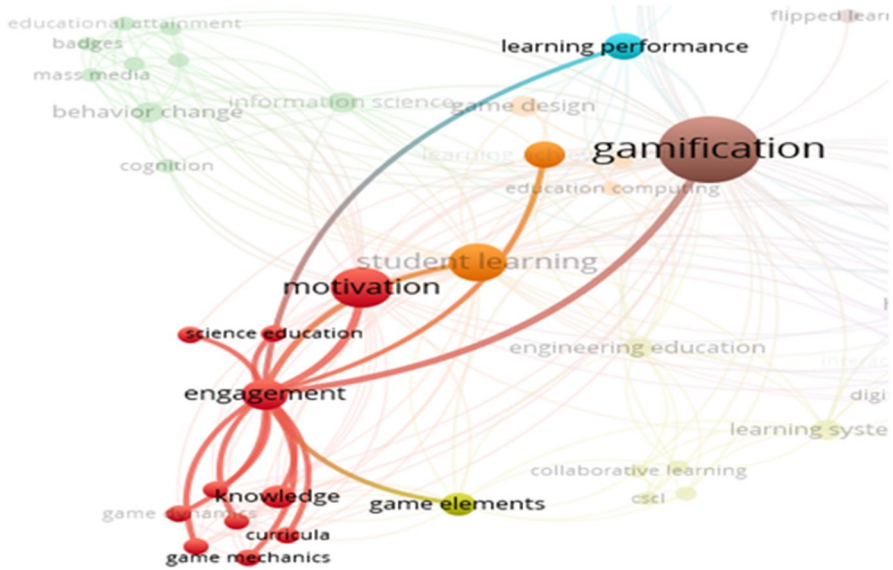


Fig. 4 Relationship of Engagement with Gamification

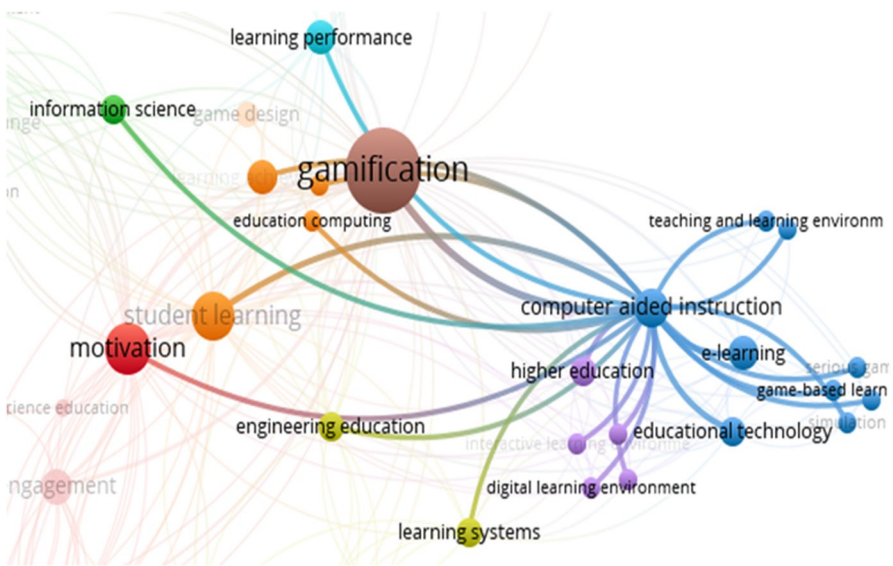


Fig. 5 Relationship of Computer aided instruction with Gamification

3.6 Participants (lesson/content/discipline and grade)

Another important item in systematic reviews and meta-analyses was the Lesson/content and the grade of gamified educational course for the participants. Table 5

Table 2 Bibliographic information on articles reviewed in systematic reviews and meta-analyses (Database, Date, No. of Article, Publication Type, and Language)

Citation	Database	date	No. of Article	Publication Type	Language
Malicki et al., 2020	PubMed, CINAHL, ERIC, and Cochrane	to 2018	23 articles	Journal	English
Bai et al., 2019	ACM Digital Library, EBSCO, IEEE Xplore Digital Library, INSPEC, ProQuest, Scopus, Web of Science	to 2018	13 articles	Journal, conference proceedings	English
Huang et al., 2020	ACM Digital Library, ACS Publications, DOAJ, EBSCOhost, Gale Databases, HEINONLINE, IEEE Xplore Digital Library, LearnTechLib, NCBI Databases, Ovid, ProQuest, Sage Journals, ScienceDirect, SpringerLink, Taylor & Francis Online, Web of Science, Wiley Online Library, World Cat	2009–2018	Qualitative: 118 Quantitative: 30	Journal, Dissertation/thesis, Conference proceeding	English
Zainuddin et al., 2020	ScienceDirect, EBSCOhost Web, Emerald Insight, Taylor & Francis Online, Wiley Online Library and SpringerLink	2016–2019	46 articles	Journal	English
Indriasari et al., 2020	ACM Digital Library, IEEE Xplore, ScienceDirect, Springer Link, Scopus, Web of Science Core Collection, and ERIC	2011–2018	39 articles	Journal, conference proceedings, book chapter	English

Table 2 (continued)

Citation	Database	date	No. of Article	Publication Type	Language
Subhash & Cudney, 2018	Academic Search Complete, ACM Digital Library, Education Full Text, ASEM Digital Collection, IEEE Xplore, PsychINFO, and Scopus	to September 2017	41 articles	Journal	English
Ortiz-Rojas et al., 2017	Web of Science	2000–2016	23 articles	Journal	Spanish, English
Kim & Castelli, 2021	The Academic Search Complete, Communication & Mass Media Complete, Education Source, ERIC, Library Information Science & Technology Abstracts, and PsycINFO	2010–2019	18 articles	Journal, conference proceedings	English
Garcia et al., 2020	Springer Link, ACM Digital Library, Science Direct and IEEE Xplore	the last five years	45 articles	Journals	English, Portuguese
Kalogiannakis et al., 2021	Science Direct, Eric, Wiley Online Library, SpringerLink, Sage Journals, Taylor & Francis Online, and JSTOR. Google Scholar	2012–2020	24 articles	Journal, conference proceedings	English
Bai et al., 2020	ACM Digital Library, EBSCO host research databases (including Academic Search Premier, British Education Index, ERIC, TOC Premier), Emerald Insight, Science Direct, Scopus, and Web of Science	2010–2018	quantitative: 24 Qualitative: 32	Journal, conference proceedings	English

Table 2 (continued)

Citation	Database	date	No. of Article	Publication Type	Language
Yildirim & Şen, 2019	Web of Science and Google Scholar	2010-2016	40 articles	Journal, Book chapter, Thesis/Dissertation Conference proceeding,	all languages
Dehghanzadeh et al., 2019	Scopus, ERIC, and Web of Science	2008-2019	22 articles	Journal, conference proceedings	English
Van Gaalen et al., 2021	Academic Search Premier; CINAHL; EMBASE; ERIC; Psychology and Behavior Sciences Collection; PsychINFO, PubMed and the Cochrane Library	to April 2018	44 articles	Journal	Dutch or English
Alomari et al., 2019	Google scholar, Springer, ERIC (education resources information system), IEEE Xplore and Science Direct	2016-2018	40 articles	Journal, conference proceedings	English
Dos Santos et al., 2020	ACM, IEEE Xplore, Springer Link, Science Direct, in conjunction with the CAPES Periodicals Portal from the Brazilian Ministry of Education	2013-2018	43 articles	Journal	English
Ortiz et al., 2016	Web of Science	2000-2016	30 articles	Journal, conference proceedings	Spanish, English
Sailer & Homner, 2020	ACM Digital Library, ERIC, IEEE Xplore, JSTOR, PubMed, ScienceDirect, and SpringerLink, Google Scholar	to March 2017	38 articles	Journal, conference proceedings	English

Table 2 (continued)

Citation	Database	date	No. of Article	Publication Type	Language
Osatuyi et al., 2018	Journals: ISR, JAIS, JCIS, JISE And major IS conference proceedings available in the Association for Information Systems	2008-2017	41 articles	Journal, conference proceedings	English
Ekici, 2021	The Web of Science, Scopus, Wiley Online Library, ERIC and Science Direct	2010-2019	22 articles	Journal	English
Brick et al., 2020	ERIC, Emerald and Elsevier	2014-2018	6 articles	Journal	-
Da Silva et al., 2019	ISI Web of Science and Scopus	to December 2017	104 articles	Journal	-
Manzano-León et al., 2021	Wos, scopus, dialent	2016-2020	14 articles	Journal	English, Spanish
Tenório et al., 2018	high quality journal; learning as primary field; computers in education as secondary field. Selected journals to this review.: IJDET, JEMH, JITE, JSET, C&E, RLTE	all year	14 articles	Journal	English
Pinto et al., 2021	ACM, IEEE Xplore, Mary Ann Liebert, Scopus, Wiley and Web of Science	1990-2020	32 articles	Journal, conference proceedings	English, Portuguese
			344 articles		

Table 3 Country/Territory, where gamified educational interventions were conducted

Citation	Country/Territory	Citation	Country/Territory
Subhash & Cudney, 2018	Spain, US, Germany, United Kingdom;	Ortiz et al., 2016	Europe, America, Asia , Africa and not specified
Ortiz-Rojas et al., 2017	Europe:12, America: 5; Asia: 4, not specified: 2	Bai et al., 2019	Asia, Europe: 4, America:3 Countries: Spain, Hong Kong and Turkey
Bai et al., 2020	East Asia:15, Western Asia: 5; Northern America: 2, South America: 2; Southern Europe: 2	Ekkci, 2021	Spain, Great Britain, Taiwan, Indonesia, Hong Kong, Turkey and Cyprus, Singapore, Mexico, Germany
Yıldırım & Şen, 2019	USA: 9, Turkey: 9, Spain: 4, England: 3; Taiwan: 3, Hong Kong: 2	Osatuyi et al., 2018	USA 53, Germany 44, Australia 22, Switzerland 12 Hong Kong 8, UK 8, Finland 7
van Gaalen et al., 2021	USA or Canada	Malicki et al., 2020	United States (6), Canada (4), Australia (2), Finland (2), Norway, Portugal, Spain (2)
Dos Santos et al., 2020	Spain		

reviews and meta-analyses used some of the most exciting gamification platforms such as Cahoot and Quizziz.

Table 7 shows that the most popular platforms are Kahoot, ClassDojo, Duolingo, Moodle, Quizziz and Khan.

3.9 The game elements

In every study in the field of the gamified educational environment, one or more game elements have been used. The game elements in educational interventions are one of the most important items that systematic review and meta-analyses articles reported them. Table 8 shows that 17 out of 25 studies examined the game elements in the included articles.

Table 8 shows that the game elements used in educational programs are very different at different levels, but some elements are used more than others. The majority of the used game elements are Point, Leaderboard, Badge, Level, Feedback, Progress bar, Challenge and Avatar.

3.10 The theories applied in the gamified educational interventions

Theories that are the basis of designing gamified learning environments are among the cases that have been studied in these types of articles. Table 9 shows the titles of these theories.

As the findings in Table 9 shows, the two theories of Self-determination theory and Flow theory in three studies and four theories, each in two studies have been reported as the most frequent theories.

Table 4 Duration parameter in gamified educational interventions

Citation	Length of Gamified Interventions
Ortiz-Rojas et al., 2017	<1 month: 4, 2—4 months: 5, 1 semester: 5, Not Stated: 6, < 1 semester: 3
Kim & Castelli, 2021	less than 1 h: 5, 2–16 weeks: 11, 1–2 years: 2
Bai et al., 2020	1 month-3 months: 10, <1 weeks: 6, ≥1 semesters: 5, 3 months-1 semester: 4, 1 week-1 month: 3, No data reported:2
Dehghanzadeh et al., 2019	< 1 Hour: 6, 1 Hour: 2, < 3 weeks: 4, 3-6 weeks: 4, 6 weeks: 2, 2 months: 1, 3 months: 1, 6 months: 1
Ortiz et al., 2016	1 semester: 16, 1-14 weeks: 7, 1-4 months: 2, 1-24 h: 1, ≥ 1 year: 1, Not specified: 1, Other: 2(14)
Bai et al., 2019	three-quarters of a term: 4, one quarter of a term: 3, two-quarters of a term: 3, more than one term: 1, No data: 2
Sailer & Homner, 2020	1 day or less, 1 week or less (but longer than 1 day), 1 month or less (but longer than 1 week), half a year or less (but longer than 1 month), more than half a year
Ekici, 2021	between 0 and 4 months long: 16, six months long: 2, shorter than a month: 3

Table 5 Discipline and Participants' levels of education in gamified educational interventions*

Citation	Lesson/content/ Discipline of the intervention	Participants' levels of education
Huang et al., 2020	Social science (Psychology, Education): 10; Engineering Computing: 6; Arts and Humanities: 5; Science (Biology, Physics): 4; Math: 2; Health (Nursing and Medicine): 1; Business, information Systems: 1; Other: 1	Undergraduate: 13; K-12: 10; Higher education: 3; Graduate: 2; Mixed higher education: 1; Mixed higher education and K-12: 1
Zainuddin et al., 2020	-	Adult/Higher education: 36; Primary schools: 5; Secondary school: 5
Indriasari et al., 2020	Physical Science, Mathematics & Computer Science: 10; Engineering: 8; Education: 7; Social Sciences: 3; Business: 3; Health Professions: 2; Other majors: 1; Unknown: 6	Elementary; High school; University
Subhash & Cudney, 2018	Computing: 14; Business, science: 5; Science: 4; Academic Distribution: 3; Entrepreneurship: 2; Communication: 2; Civil: 1; Language: 1; Manufacturing Engineering: 1; Mechanical Engineering: 1; Nursing: 1; Pedagogy: 1; Psychology: 1	Higher education
Ortiz-Rojas et al., 2017	Science, Technology, Engineering and Mathematics (STEM): 19; Communication: 1; Financing: 1; Use of Photoshop: 1; Designing Questionnaires: 1	Higher Education: 19; High School: 2; Middle School: 2
Kim & Castelli, 2021	-	College students: 10, Adults: 6, k-12: 2
Garcia et al., 2020	Mathematics, Teacher: 2, Student: 33, Both: 1, Unknown: 9	Higher Education: 19, Middle School: 16, Both: 1, unknown: 8
Kalogiannakis et al., 2021	Biology or Health: 8; Physics: 5; Chemistry: 2; Natural Sciences: 9	Higher education: 10; Secondary education: 9; Primary education: 5
Bai et al., 2020	Arts: 3; Computer & information: 9; Language: 7; Research methodology: 3; Science: 3; Health education: 2; Mathematics: 2	Undergraduate: 10; Elementary school: 9; High school: 5; Postgraduate: 3; No data reported: 2
Yıldırım & Şen, 2019	Non-technology: 30; Technology: 15; Overall: 45	Primary school: 5; Secondary school: 6; High school: 4; University: 30; Overall: 45
Dehghanzadeh et al., 2019	English, Learning vocabularies: 15; Grammar: 5; Pronunciation: 4; Speaking: 5; Writing: 3; Listening: 4	High schools: 10; Higher education: 7; Elementary schools: 4
Van Gaalen et al., 2021	Health, Surgery, Anatomy & physiology, Anatomy learning Attitudes towards aging, Auscultatory skills, Biology Breast imaging, Clinical reasoning, Critical care, Hypertension treatment, Internal medicine, Learning about, Learning critical thinking, Life-support training, Microbiology, Pediatric knowledge Pharmaceuticals, Physiology, Quality improvement, Radiology Resuscitation principles, Scientific writing, Urine catheterization	Residents: 11, Medical students: 14 Nursing: 4, Allied health students: 1 Specialists: 3, Osteopathic students: 1 Pharmacy students: 1 Nursery: 3, Primary care physicians: 1 Speech-Language and Hearing Science: 1, Medicine (mixed): 3, Dentistry: 1
Dos Santos et al., 2020	-	High/technical school: 18; General education: 11; Higher education: 7; Elementary school: 5; Early childhood education: 2
Ortiz et al., 2016	STEM, computer science: 25; Science/Technology: 2; Math: 1; Chemistry: 1; Not specified: 1	Higher Education

Table 5 (continued)

Citation	Lesson/content/ Discipline of the intervention	Participants' levels of education
Bai et al., 2019	-	Undergraduate:9, Elementary school:1; High school: 1; High school + undergraduate + postgraduate: 1, Postgraduate: 1
Sailer & Homner, 2020	-	School setting, Higher education setting
Ekici, 2021	STEM, information science and information and communication technologies: 12, educational sciences: 2 English learning: 2 personal and professional development: 2	College: 18; High school: 3; Primary school: 1
Manzano-León et al., 2021	Physical education, Foundations of the curriculum and physical Education, Sciences, Industrial technology, MSc in Software Engineering for the Web, Advanced quantum mechanics course Online seminar of psychology, Second language(English), Ethical education, Matter and Energy subject in Primary, Education Degree Psychology courses, Math	University: 6; School: 3; High School: 3; School and high school: 2
Pinto et al., 2021	Language: English: 21; German: 3; Chinese: 2; Japanese: 1; Basque: 1; Mandarin: 1; Amazigh: 1; Danish: 1	Primary education or first stage of basic education: 9; Lower secondary or second stage of basic education: 5; Pre-primary: 2; Secondary: 2; First stage of tertiary: 2; Post-secondary non-tertiary: 1; Second stage of tertiary: 1; Participants recruited from the university community: 1; 21 years old: 1; 21 to 55 years old: 1; Students from an higher education foreign language course: 1; Do not inform: 9

* The numbers in the table refer to the number of articles with this situation in each systematic or meta-analysis(Citation)

Table 6 Samples size in gamified educational interventions

Citation	Sample size
Ortiz-Rojas et al., 2017	21-100 students: 12; 101-200 students: 3; 201-300 students: 2; ≥ 301 students: 5; Not mentioned: 1
Bai et al., 2020	<50 students: 13; 50–100 students: 8; ≥ 150 students: 8
Dehghanzadeh et al., 2019	<50 students: 11; 50–100 students: 7; >100 students: 3
Ortiz et al., 2016	<10 students: 1; 11-60 students: 13; 61-110 students: 5; 111-470 students: 9; 2263 students: 1; Not mentioned: 1
Ekici, 2021	<60 students: 8 1 <120 students: 14; Not mentioned: 2

3.11 Discussion

This study is a scientometrics, systematic, and co-occurrence analyses of systematic review and meta-analysis articles in the field of gamified education. According to our findings, 7 out of 24 articles were systematic reviews and the rest were meta-analyses with publication dates from 2000 to 2020.

Co-occurrence analysis of words indicated that motivation, learning and engagement are the most important concepts studied in articles in the field of gamified education. The results of a study showed that performance, participation, attitude, motivation, pleasure, perceived learning, satisfaction, practical skills, and increased learner competition are some benefits observed in studies related to gamification in education (Subhash & Cudney, 2018). In fact, learning engagement and motivation, learning achievement, interaction and social connection are some effects of these kinds of intervention. Gamified tests at the beginning and the end of each class increase learners' mastery of lesson content and engagement during class activities, as well as improve their cognitive, emotional, and behavioral engagement (Zainuddin et al., 2020). Gamification can be directly related to increasing learners' learning

Table 7 Platforms used in gamified educational interventions*

Citation	Platforms
Zainuddin et al., 2020	Adapted gamification platforms: ClassDojo and ClassBadges, Ribbonhero of Microsoft Rain classroom, Quizbot, Duolingo Kahoot and Quizizz, Math Widgets, Google + Communities iSpring Learn LMS learning management system: MOOCs (Coursera, Udacity, and edX), wiki platforms, moodle platforms or institutional LMS
Kalogiannakis et al., 2021	Pre-existed gamified platform: Kahoot, ClassDojo, Socrative, Quizizz, Zondle, and 3D GameLab
Dehghanzadeh et al., 2019	WordBricks, Duolingo, Kahoot, Babbel, Jeopardy, ClassDojo, Lifeline, Feelbot, Brainscap
Ekici, 2021	Moodle, Kahoot, Blackboard, Socrative, iSpring Learn LMS, The Minimum Learning Judgement System, VoiceTube, Quizizz, Khan Academy LMS, Electronic Book

performance. However, some studies reflect weaker statistical differences between on-game and off-game environments (Ortiz-Rojas et al., 2017). The results of the studies indicate that in some gamified educational interventions, no improvement was observed in final exam scores, but perceived learning was widely concluded as a positive effect of gamification learning. Improving learners' performance in presenting higher quality projects, improving learning outcomes, reducing failure rates and higher average scores are also observed in game-based learning groups (Subhash & Cudney, 2018). The results of another study also showed that the level of participation had a higher effect size than the test score. Therefore, gamification has a greater effect on the level of learners' participation than the test score. Increasing the level of participation can develop learning skills and academic achievement. Thus, educators are expected to improve learners' participation levels using gamification strategies (Kim & Castelli, 2021).

In terms of content analysis, researchers extracted 7 fundamental categories. In the following, we have discussed every category.

3.12 Country/territory

Because of cultural differences in every country, learners' attitude and expectations might be different about learning via gamification (Subhash & Cudney, 2018). In addition, based on educational subjects, learners in different countries have different tendencies to gamified learning. For instance, in the field of higher education, Spain is the first country in regard with the highest number of studies in gamified learning and United States, Germany, and the United Kingdom are in the next ranks, respectively (Ortiz-Rojas et al., 2017). To measure the student learning outcomes, East Asia with 15 and Western Asia with 5 articles are in the first and second ranks (Bai et al., 2020). About the effect of gamification on academic success in students, both USA and Turkey (9 articles) and Spain (4 articles) have the most studies (Yıldırım & Şen, 2019). A systematic review by Gaalen et al. showed that in the field of medical education, the majority of studies were conducted in the USA and Canada (Van Gaalen et al., 2021). However, in terms of the use of gamification in collaborative learning, Spain had had conducted the highest number of studies (Dos Santos et al., 2020). European countries are pioneers in research on the application of gamification in Science, Technology, Engineering and Mathematics (STEM), followed by America, Asia and Africa, respectively (Ortiz et al., 2016). Moreover, researchers in countries such as Spain, Hong Kong and Turkey have shown great interest in gamified learning methods in measuring learners' learning performance in this field (Bai et al., 2019). Flipped learning is another field that has attracted gamification. While the studies in this field have been conducted in 12 different countries, Spanish researchers have the first rank and more than half of studies have been conducted in European countries (Ekici, 2021). The investigation of studies in the field of gamified education in information systems (IS) showed that Americans, Australians and German' researchers published 53, 44 and 22 articles, in turn (Osatuyi et al., 2018). Eventually, in the gamified nursing education, the United States and Canada have the highest number of publications (6 and 4, respectively) (Malicki et al., 2020).

Table 8 Game elements used in gamified educational interventions*

Citations	Game elements (the number of studies that used the element) and the number of articles using these elements in every citation
Huang et al., 2020	Points/experience (24), Leaderboards (23), Badges/awards (22), Competition (21), Responsive feedback (19), Advancement/levels (14), Quests/missions/modules (12), Collaboration (9), Avatars/customization (8), Timed activity (6), Performance graphs (6), Non-linear navigation (5), Adaptivity/personalization (5), Narrative/storytelling (5)
Zainuddin et al., 2020	Point (38), Leaderboard (33), Badges (33), Levels (21), Trophies (7), Avatars (6), Gift (5), Progress bar (5), ranking (5)
Indriasari et al., 2020	Points (27), Leaderboards (22), Badges (26), Progress Bar (5), Virtual Gift (5), Level (4), Mission/ Quest (2), Prize (1)
(Subhash & Cudney, 2018)	Point, leaderboard, badge, level, feedback, collaboration, graphics, design (goals, rules, time limit, competition), narrative, freedom to fail, real reward, role play
Ortiz-Rojas et al., 2017	Badges (13), Leaderboard (10), Points (6), Levels (4), Ranking (4), Challenges (3), Trophies (3), Virtual Currency (1), Feedback (1), Hearts (1), Quests (1), Scoring (1), Achievements (1), Avatars (1), Awards (1)
Kim & Castelli, 2021	Badges 15, leaderboard 14, points 13, progress bar 5, Challenge2, levels 2, avatar2, goals 1, peer assessment 1, storytelling1, prize1
Garcia et al., 2020	Feedback (29), Pontuation (29), Levels (25), Rewards (21), Goals (19), Cooperation (15), Narrative (15), Real time (8), Objective History (1)
Kalogiannakis et al., 2021	Competition (15), points (13), levels (12), Leaderboard (12), Progression (11), Badges (6), Time- pressure (5), Rewards (4), Cooperation (4), Storytelling (3), Quizzes (3), Avatar (3), Score (2), Story-based (2), Narrative (2), Challenges (2), Collaboration (2), Stats (1), Repeat-testing (1), Puzzle (1), prizes (1), Goals/objectives (1), Feedback (1)
Dehghanzadeh et al., 2019	Feedback (22), Challenge (12), Reward (11), Point (11), Leaderboard (8), Level (7), Time pressure (6), Progress bar (6), Badge (5), Score system (3), Like or dislike (3), Narration (2), Answer question (2), Quest (2), Story (2), Achievement (2), Avatar (2), Character system (2), Curiosity (2), Emoticon (1), Fantasy (1), Mission (1), Virtual credit (1), Medal (1), Performance graph (1), Use of social media (1), Warning signal (1), Wall (1), Control (1), Appreciation (1), Freedom to fail (1), Chatting with users (1), Message (1), User guidance (1), Status (1), Rule (1), Specific phrases (1), Competition (1), Uploading (1), Chunking (1), Correctness bar (1), Peer assessment (1), Error typing (1), Profile (1), New feed (1)
Van Gaalen et al., 2021	Scoring/Points (15), Competition (13), Rewards (7), Time (6), Teams (4), Levelling (3), Crossword puzzle (2), Spaced-learning (2), Social network (2), Surprise (2), Role playing (1), Avatar (1), curiosity (1), Progress (1), signposting (1), Mystery character (1), Awards (1), Badges (1), Chance (1)
Alomari et al., 2019	Points (30), Badges (27), leaderboards (25), Levels (14), Progress bar (5), Challenge (4), Feedback (4), Achievement rewards (3), Avatars (3), Quests (2), Ranking (2), Rewards (2), Social engagement (1), Storyline (1), Thumbs –ups (1), Trophies (1), Win-state (1), Real gifts (1), Reputation (1), Narrative (1), Progressive levels (1), group competition (1), Comparisons (1), Constraints (1), Cards (1), Awards (1)
Ortiz et al., 2016	Combination (18), Badges (7), Leaderboard (2), Points (1), Challenge (1), Quests (1)
Ekici, 2021	Points (17), Badges (14), Leaderboard (8), Levels (2), Progress bar (1), Virtual coins (1), Virtual Objects (1), Rewards (1)

Table 8 (continued)

Citations	Game elements (the number of studies that used the element) and the number of articles using these elements in every citation
Manzano-León et al., 2021	Points (10), Narrative (8), Badges (7), Ranking (6), Rewards (6), Challenge (4), Prize (3), Levels (3), Playful activities (2), Tasks (2), Events (1), Roles (1), Feedback (1), Choices (1), Competition (1), Achievements (1)
Tenório et al., 2018	Badges (9), Points (8), Leaderboard (6), Level (5), Avatar image (4), Teams (4), Avatar in 3D (3), Social Graph (3), Virtual Goods (2)
Bai et al., 2020	Badges + leaderboard/rank + points (8), Badges + leaderboard/rank + levels/unlock + points (6), Badges + points (4), Points (3), Badges + levels/unlock + points (3), Avatar+leaderboard/rank+levels/unlock +points+progress bar+team (collaboration, competition) (3)
Bai et al., 2019	Badges + leaderboard/rank + level/unlock + points: (4), Badges + leaderboard/rank + points (2), Badges + points + progress bar (1), Badges + leaderboard/rank + level/unlock + progress bar (1), Badges + leaderboard/rank + level/unlock (1), Badges (1), Badges + leaderboard/rank (1), Level/rank + points (1), Avatar + badges + leaderboard/rank + level/unlock + points + word notification (1)

* The numbers in the table refer to the number of articles with this situation in each systematic or meta-analysis(Citation)

Table 9 Theories used in gamified educational interventions

Citation	Theories
Zainuddin et al., 2020	Self-determination theory; flow theory; The goal-setting theory; Cognitive evaluation theory; Cognitive load theory; Behaviour reinforcement theory; Social comparison theory; Theory-driven gamification design model: goal, access, feedback, challenge and collaboration; Theory of reasoned action; Rational choice theory; Taxation theory; Information systems success model/information systems theory; Presence pedagogy model; Eisenkraft's 7E instructional Model; Felder-Silverman learning style model; Unified Modelling Language; Fogg's behavior model; Merrill's first principles of instruction design theory; Landers' theory of gamified learning; Social development theory: zone of proximal development and scaffolding; Self-efficacy theory; Constructivist learning theory; Technology-enhanced training effectiveness model
Kalogiannakis et al., 2021	self-determination theory; flow theory; goal-setting theory; cognitive theory of multimedia learning; motivation theory to learn
Osatuyi et al., 2018	Self-determination theory; Flow theory; Situated learning theory; Experiential learning theory; Uses and gratifications theory; Zone of proximal development; Achievement goal theory; Activity theory; Andragogy theory of adult learning; Cognitive evaluation theory; Cognitive load theory; Constructivist theories of learning; Grounded theory; social capital theory; Social cognitive theory; Social exchange theory; The frame model; The organismic integration theory (OIT); The SNAP: model of motivation; Trans-theoretical model of behavior change (TTM)
Van Gaalen et al., 2021	Experiential Learning Theory; Reinforcement Learning Theory; Social Comparison Theory; Self-Directed Learning; Deliberate Practice Theory

3.13 Duration

An important parameter in gamified learning is how long the intervention has taken place. In fact, it is important whether the effects of gamification last long time or not (Dichev & Dicheva, 2017; Hamari et al., 2014; Seaborn & Fels, 2015). Because duration of gamified course is considered as a potential modifier of effects on the results of cognitive, motivational and behavioral learning. However, there are conflicting findings in this regard. According to Wouters et al. (2013) when the participants participate in several sessions and play for longer period of time, the effects of games are greater, while findings of Kim and Castelli (2021) about the effect of gamification on behavioral change showed that gamified interventions lasting some days is more effective than those lasting one or two years. Thus, the studies recommend the short courses rather than longer ones in gamified learning. Another analysis carried out by Sailer and Homner indicated that both long and short-term interventions are useful in cognitive and behavioral learning. However, the interventions that lasted for half a year or less (but more than 1 month) have a moderate effect on motivational learning outcomes, while the effectiveness of interventions of one-day courses or less were negligible. In fact, for motivational outcomes, it may even take longer time to affect motivation. However, this does not lead to any conclusions about the durability of the effects obtained (Sailer & Homner, 2020). Based on Ekici (2021), the duration of gamification used in learning is up to 4 months. Hanus and Fox's findings highlights the negative effect of long-term gamification courses on intrinsic motivation, academic achievement and satisfaction while many studies have been conducted in a relatively short period of time (less than four months) (Hanus & Fox, 2015). For example, Hung (2017) used Kahoot for gamifying their education course in the control group, and the results showed that it was effective on increasing motivation and academic achievement in the short term. In another study, Chen and Hwang (2019) used Kahoot for only six weeks.

3.14 Game elements

There are three important issues with game elements including the type of element, the number of elements and the type of combination of game elements.

3.15 Type of used element

Our findings show that the game elements used in learning interventions do not have the same effects on learners' learning. For example, Huang et al. (2020) found that using a timed activity element produces a smaller effect size than other elements, while environments that do not use this element have a larger effect size. The same is true about the leaderboard element, though the difference is not significant. Even some studies showed that the most controversial element is the leaderboard that may harm learners' motivation when they are doing an explicit competition. However, in almost all articles, leaderboards were introduced as the most attractive elements of the game (Zainuddin et al., 2020). One study showed that the main game elements

used in learning are points, medals, rankings, and narratives (Manzano-León et al., 2021). Nevertheless, a large number of studies showed that the most frequent elements are points, badges, and leaderboard (Ekici, 2021; Indriasari et al., 2020; Subhash & Cudney, 2018; Tenório et al., 2018; Zainuddin et al., 2020). On the other hand, few studies have reported quest, virtual goods or gifts as the game elements (Indriasari et al., 2020). Collaboration was also one of the most common game elements used in the form of teammates and discussion boards. The results of Subhash and Cudney's study illustrated that points, badges, leaderboard, levels, feedback, and graphics, as the most important game elements, are suitable for higher education environments (Subhash & Cudney, 2018).

3.16 Number of elements

There are also challenges regarding the number of elements used in gamification. Ekici's findings showed that most studies used more than one game element (Ekici, 2021) because when only one or two game elements such as points or badges are used in educational interventions, the effects on students' motivation are becoming less or even negative. Manzano-León et al.'s research reinforces the idea that a diverse gaming environment is more motivational and can meet the needs of its players according to their characteristics, a result consistent with that of the Kocadere and Çağlar (Manzano-León et al., 2021). According to Indriasari et al., 62% of studies used a combination of game elements, while only 15 studies reported using only one element (Indriasari et al., 2020). However, Manzano-León et al. (2021) showed that there was no significant difference between the effects of interventions that used more elements of the game with other interventions. Based on their findings, in different interventions, four elements, three elements, two elements, one element and six game elements have been used, respectively.

3.17 Combination of game elements

One of the important issues is the combination of game elements. While the greatest effect size for the gamification design feature was observed in the use of quests/missions/modules in the interventions (Huang et al., 2020), the results of several studies revealed that in most of the gamified educational interventions, the combination of badges+leaderboards+points is often used (Ekici, 2021; Kalogiannakis et al., 2021; Ortiz-Rojas et al., 2017). Bai et al. (2019) indicated that in some studies, the most used combination include badges, leaderboard/rank, level/unlock and points, followed by badges, leaderboard/rank, and points. The ranking of the impact of elements in terms of effect size alone or in combination with other elements in Huang et al.'s study is as follows: Quests/missions/modules, Collaboration, Avatars/customization, Adaptivity/personalization, Non-linear navigation, Responsive feedback, Advancement/levels, Narrative/storytelling, Points/experience, Badges/awards, Competition, Leaderboards, Performance graphs, Timed activity (Huang et al., 2020).

3.18 Participants (field of study and grade)

3.18.1 Participants' field of study

The study by Bai et al. (2020) showed that there is no significant difference between gamification in different fields of study. They found that the effect size was not affected by student's grade level of education (e.g., elementary, high school and college students) and subject disciplines (e.g., computer and information science, math, science). However, various studies indicated that in some areas of science, gamification is more highlighted. The study by Huang et al. (2020) illustrated that most of the fields in which gamification was introduced were "social sciences" and "engineering and computer", both of which had a statistically significant effect size. In contrast, in subject areas such as "arts and humanities" with the effect size, was not statistically significant. Subject areas such as Math, Health care, and Business used less gamification in their educational settings. However, the study by Indriasari et al. indicated that most types of the gamification was applied in the fields of Physical sciences, Mathematics and Computer science, Engineering and Education. In addition, Science, Technology, Engineering, and Math (STEM) are disciplines in which most of the peer-to-peer review activities (Indriasari et al., 2020) and flipped gamification learning (Ekici, 2021) were reported. Subhash and Cudney also showed that 14 out of the 37 studies in the field are computing (Kim & Castelli, 2021).

3.18.2 Participants' degree

In terms of participants, the results are somewhat contradictory. According to a study by Bai et al. (2020) the effect size in the high school environment was significantly larger than those in undergraduate and graduate levels. Their findings showed that the effect size was not affected by the participants' degree. Even Yıldırım and Şen (2019) showed that the effect of gamification on students' progress in different degrees of education was not different. Bai et al. (2020) showed that most of the studies were conducted with undergraduate students with the highest effect size and K-12 students were in the next rank but there was no significant difference. Yet, it is not surprising to see more studies on undergraduate education because they are more accessible for researchers in their institutions. However, the results of Bai et al. showed that the effect size of undergraduate students is almost twice as much as that of K-12 students. Zainuddin et al. (2020) also illustrated that most of the articles studied were related to adult learners or higher education students. The results of the study by Indriasari et al. (2020) also confirmed that a small number of studies were related to high school and primary school, and most of the articles were conducted in the university level, even in the studies of flipped education (Ekici, 2021). Perhaps, this is why, despite the results of some studies (Bai et al., 2020; Sailer & Homner, 2020; Yıldırım & Şen, 2019), gamification is not statistically significant in high school level (Yıldırım & Şen, 2019) and the effects of gamified interventions are much more effective for adults than K-12 and college students. In fact, it is possible that younger people and adults are more interested in the gamified factors in education than the age groups of college students. Because adults showed the highest

participation rate compared to college students and K-12 students (Kim & Castelli, 2021). Only Sailer and Homner's study showed that gamified cognitive learning in school was better than other educational environments (Sailer & Homner, 2020). What is certain is while the majority of the research were related to students, a small number of studies in this field have provided solutions that are directly aimed at teachers (Garcia et al., 2020). More information about study field of the intervention and the participants' level of education is shown in Table 6.

3.19 Gamification platforms

The platforms and applications used in gamified learning research are other considerable issues. The results of one of these studies by Zainuddin et al (2020) showed that most of the articles used existing platforms from different sources such as ClassDojo and ClassBadges, Ribbonhero of Microsoft Rain classroom, Quizbot, Duolingo, Kahoot and Quizizz, Math Widgets, Google + CommunitiesSpring Learn LMS. The most common of these is Kahoot (Kalogiannakis et al., 2021). The integration of game elements in the Learning Management System (LMS) is also used. For example, by integrating gamification using Web 2 tools, new functions are created for MOOCs (Coursera, Udacity, and edX), wiki and moodle platforms, and enterprise learning management systems (Aparicio et al., 2019; Huang et al., 2019; B. Huang & Hew, 2018; Jurgelaitis et al., 2019; Özdener, 2018). In addition, the National Budget Forecasting project is another platform used (Buckley & Doyle, 2017). Some researchers have developed their game development platforms to prioritize user-centric needs and help to provide an effective online experience for a diverse range of users. Their goal is to improve the performance and participation of inclusive learning (8, 9) and to participate in online discussions using the tools of the game (Bouchrika et al., 2019; Ding, 2019; Ding et al., 2017, 2018). In terms of applying gamification in teaching English, different types of digital learning environments such as WordBricks, Duolingo, Kahoot, Babel, Jeopardy, ClassDojo, Lifeline, Feelbot, Brainscap have been used to play LESL (Dehghanzadeh et al., 2019). The predominant environment/tool of gamification in flipped game education research are learning management systems such as Moodle, iSpring LMS, Blackboard, The Minimum Learning Judgment System, and Khan Academy LMS. Moodle was used in 9 studies and Kahoot in 7 studies, which were ranked first and second (Ekici, 2021).

3.20 Theories in gamified learning

The theories used in the design of gamified educational environments are the other important element. Self-determination and Flow theories (Kalogiannakis et al., 2021; Osatuyi et al., 2018) are the most frequent theories used in gamified studies. These two theories have been widely used in gamified studies of educational environments (Zainuddin et al., 2020). According to Kalogiannakis et al. (2021) that conducted a systematic review of articles related to gamification in

science education, most of the articles included in the systematic review had no theoretical basis. Of the 24 studies reviewed, only six articles implicitly stated their theoretical framework, which self-determination theory is one of the most comprehensive and significant one. The results of a study by Osatuyi et al. (2018) showed that only 17 out of 41 existing articles were theoretically based. The results of this study showed that the following theories were dominant among the theoretical frameworks used in game development research:

Social theories (such as theories that support psychological processes such as social exchange theory, social capital theory, social cognitive theory);

Cognitive theories (such as cognitive evaluation theory, cognitive load theory, Kolb's experiential learning theory, Lave's situated learning theory, and constructivist theories of learning);

Behavioral theories (such as self-determination theory (SDT) and flow theory).

4 Conclusion

The results showed that 344 articles in the field of gamified learning and education were reviewed in 25 systematic review and meta-analysis articles, most of which were in English. Therefore, there is a lack of systematic review research for articles in other languages. Content analysis showed that these 25 articles can be categorized in 7 categories based on the most important elements in the field of gamification and learning, including country/territory, duration of intervention, lessons/content, the number of learners, platforms, the game elements, theories. Based on results, all these items were not analyzed in all 25 articles. Therefore, it is suggested that these seven items be considered in subsequent systematic reviews studies and meta-analyses. In addition, the results showed that most of these studies have implemented gamification in online learning environments. There is a need for more research to gamify face-to-face classes.

On the other hand, most of the review articles were in the field of "social sciences" or "engineering and computer". It is suggested that studies be conducted to examine interventions in other disciplines and courses. The results showed that in most studies, due to time and cost issues, they preferred to use existing platforms and LMS.

The results of some studies showed that educational interventions were effective in promoting learning, motivation and participation of learners, but in most of these studies, the definite effect of gamification was not mentioned and among these research suggestions, the need for further studies was suggested. The results of some studies also reflected weaker statistical differences between gamified and non-gamified environments. Therefore, it is suggested that the higher quality studies (two groups with pre-test and post-test) be performed to determine the effect of gamification on variables. Finally, due to the inconsistency of the results of these

studies, it is suggested that systematic review and meta-analysis studies focusing on the seven variables proposed in the present study.

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Author 2: Contributed to conception, design, data acquisition and interpretation, performed all analyses, drafted and critically revised the manuscript.

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Declarations

Conflict of interest The authors declare that there is no conflict of interest.

Ethical standards This research did not involve Human Subjects.

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