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Gamification and Game Based Learning for Vocational Education and Training: A Systematic Literature Review

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Abstract

Games have been used as a learning tool for centuries. Gamification and game-based learning are becoming more prominent in educational settings for several reasons. When it comes to learning, being focused and immersed can massively improve a student's experience. The purpose of this study is to map the emerging trends of gamification and game-based learning (GBL) in the Vocational and Education Training (VET) sector. For this purpose, a Systematic Literature Review was conducted through the three most relevant scientific databases – Web of Science, Scopus, ScienceDirect, and PubMed with Google Scholar as a supporting database. The obtained sample was further selected following the PRISMA guidelines with screening and eligibility processes conducted based on inclusion criteria that were defined with consideration to the research's aim. This review comprised seventeen studies. The findings revealed a growing interest in the Asian continents in research from 2020 onwards. Furthermore, most of the study is centred on vocational schools and colleges in the engineering and healthcare fields. According to the overview, the digital learning platform and simulation technology are the most promising tools used in the research. The findings support the conclusion that gamification and game-based learning can improve academic performance, engagement, and motivation in vocational education learners. As a result, this study suggests that more research is needed to determine the gamification strategies that are most suited for vocational education and learning.

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1 Introduction

Technology is growing at a rapid pace nowadays, allowing for faster change and advancement, and those wanting to remain at the helm of innovation must adapt. The rising dependency on technology, most notably the internet (Sufian et al., 2020), around the world contributed to convenience, reduced cost (Dhirendra Kumar, 2015; Gagnon & Gagnon, 2021), and has created the illusion of a smaller world (Alghamdi et al., 2020). Emerging technologies like sophisticated robots, artificial intelligence, and blockchain are accelerating global transformation at a rate never seen before (Economic Planning Unit, 2014; Omar et al., 2022) and unavoidably transform the world of employment. An analysis of various National Classification of Occupations (NCO) data revealed the creation of 54 new job titles out of 2,945 (1.8 per cent) in India between 1968–2004; 114 out of 3,600 (3.2 per cent) in India between 2004–2015; 26 out of 2,338 (1.1 per cent) in Malaysia; 18 out of 498 (3.6 per cent) in the Philippines; and 16 out 506 (3.2 per cent) in Vietnam (Khatiwada & Veloso, 2019). These new job titles that mainly emerged in the professional, technical, and associate professional divisions demand a higher degree of skills and competence. Thus, educational systems at all levels, most notably vocational education and training, must evolve with the technology to adequately prepare current and future workers for transitioning to high-skilled jobs. However, current education systems are ill-equipped to meet the changing skill needs (Ra et al., 2019).

In recent years, numerous technological advancements have been made in the educational sphere, allowing for the invention and development of effective teaching and learning models capable of fulfilling the expectations of future employment requirements (Garzón-Artacho et al., 2021; International Labour Organization, 2020; Yunos et al., 2017; Zabolotska et al., 2021). Even prior to the pandemic, education was transitioning toward a digital-first environment, and it was a challenge to educational institutions. The digital transition is a convergence of digital and pedagogical technologies in order to create digital educational materials, digital didactics, and other cutting-edge pedagogical strategies with the aim of increasing student engagement and satisfaction (Martin & Bolliger, 2018; Sage et al., 2021), boost psychological needs towards motivation (Chiu & Lim, 2020; Reeve, 2018), promote inclusion, improve feedback practises, accelerate and deepen leaners' comprehension of a subject, and make educational activities more learner-centred (Shagataeva, et al., 2021; Zabolotska et al., 2021).

The migration of face-to-face instruction at schools towards online learning due to the Covid-19 pandemic has affected approximately 95% of the world's student population, resulting in the largest education interruption in history and opening doors to student-centred learning (Engzell et al., 2021; United, 2020). The COVID-19 outbreak is swiftly illustrating why education technologies should be a critical component of teaching and learning since they play a critical role in delivering education to students outside of school as well as embracing the changes and

uncertainty. Malaysia's government, without exception, promptly implemented a 'Movement Control Order' on 18 March 2020 and executed online learning migration as a new norm to halt the spread of disease and alleviate the burden on the health system (Sia & Adamu, 2021). Even though Malaysia was well prepared due to its rapid attempts to develop a policy framework, (Organisation for Economic Co-operation and Development (OECD), 2021), 27% of 18 digital education experts based in 10 different EU countries and Malaysia indicated that the digitalisation of offline education was the most challenging during the COVID-19 outbreak (DEL4ALL, 2020). It developed certain drawbacks, including restricted social connection, increased technological costs and scheduling, decreased assessment efficacy, and instructor's competency skills (Dhirendra Kumar, 2015; Yasak & Alias, 2015; Yeap et al., 2021).

Despite our discussion of Education 3.0 and Education 4.0, the reality is that many countries, including those developed, lack even basic and continuous internet access (Vijayan, 2021). Even in affluent countries' education systems, lack of instructors' digital readiness, supporting infrastructure for online learning and low Internet connectivity or coverage have been identified as concerns (Baser et al., 2021; Garzón-Artacho et al., 2021; Shagataeva et al., 2021; Wardoyo et al., 2021). However, Dubé and Wen (2022) identified seven clusters of technology forecasts for the most prominent educational technologies from 2011 to 2021, based on data from seven Horizon Reports published between 2011 and 2017. The technologies are: (i) mobile technology, (ii) maker technology, (iii) analytics technology, (iv) games, (v) simulation technology, (vi) artificial intelligence (AI), and (vii) other technologies. The research anticipated that mobile technology would be the most prominent educational technology from 2011 through the near future. Maker technology and games, respectively, were forecasted to have an influence on education from 2015 to 2018 and 2012 to 2016. The impact of analytics technology was projected to grow and influence learning, alongside other technological advancements such as Virtual Reality (VR) and Artificial Intelligence (AI). Therefore, the aim of this study is to perform a systematic literature review of the current trends and patterns in educational gamification and GBL for vocational education, as well as to identify the most effective educational gamification or GBL projects that may be replicated in the future.

1.1 Vocational Education and Training (VET)

Vocational Education and Training (VET) encompasses formal, non-formal, and informal learning that equips individuals with the requisite information and skills for the workplace. The term "vocational education and training (VET)" refers to the education, training, and development of skills in a wide variety of occupational domains, production, services, and lifestyles (UNESCO, 2015). It focuses on developing a new skilled workforce that possesses both technical and interpersonal abilities, existing workers who wish to improve their employability through continued skill development, and students who intend to pursue higher education in the future which can help countries improve their economic development and remain

competitive in a globalised world (OECD, 2019). Technical and vocational education and training (TVET) is a word that is frequently used interchangeably with vocational education and training (VET) in the Asia–Pacific area, including Malaysia (National Centre for Vocational Education Research, 2020). VET programmes can be either mainly school-based or work-based.

The curriculum of TVET in Malaysia is designed in accordance with the National Occupational Skills Standards (NOSS) geared toward improving the quality as well as productivity of the country's skilled labour force (Department Skills Development, 2022). NOSS is a document that outlines the knowledge, skills and behavioural competencies related to occupations and is developed based on industry requirements. TVET adopt Competency-Based Education/Learning (CBE/L) principles in the vocational training system in Malaysia which entails shifting emphasis from an instructor-centred approach toward a trainee-centred approach. Statistically, Kulyk et al. (2022) discovered that the labour market's demand for competent professionals in vocational education is increasing each year. Malaysia's Budget 2018 allotted RM4.9 billion to seven ministries and agencies involved in TVET to develop a highly trained and competitive workforce (Abdul-aziz et al., 2020).

However, due to the industry's emphasis on practical skills and hands-on training, online learning was not a favourable choice for the VET instructor (Arnold et al., 2021; Yeap et al., 2021). The UNESCO-UNEVOC International Centre (2020) reported that one-third of all respondents in 126 countries did not use e-learning, another third used it occasionally, 17% used it regularly, and only 11% used it very often. Hence, the complete transition to online learning due to the Covid-19 pandemic was felt most acutely in the VET sector (UNESCO-UNEVOC, 2021; Yeap et al., 2021) where most skill-based institutions were caught off guard by the lack of infrastructure and necessary resources to facilitate online learning (Sia & Adamu, 2021). Worse, instructors experienced mental stress because of unprepared situations arising from the preparation, presentation, application, and confirmation stages of online teaching and learning. Previous research lists several issues that plague the VET field (Gaffoor & Van der Bijl, 2019). Among the reasons revealed in the study were the instructor's lack of competency and the students' heavy course load, both of which contributed to the students 'low academic performance. The report found that this might relate to courses being taught more theory-heavy than practical sessions and suggested that learning should be made more entertaining and interesting. An adequate intervention is necessary to address motivational and performance issues in vocational education.

1.2 Instructor Digital Competence

Digital competencies empower instructors to maximise digital technologies' potential. To facilitate the teaching–learning process of students and foster the development of important skills, it is required for instructors to have up-to-date training and a specific degree of digital competence. In Malaysia, concerns about the capabilities of TVET lecturers in terms of their proficiency, credentials, and skills competence have been a focus of the country's instructor education program (UNESCO, 2021). In recent years,

the instructor education program has seen the emergence of new methodological perspectives due to technological resources and mobile connections (Gómez-Carrasco et al., 2020). Having a qualified instructor with a high level of digital competence and technological proficiency is substantial in VET training programmes (Kulyk et al., 2022; UNESCO-UNEVOC, 2020; Yasak & Alias, 2015; Zabolotska et al., 2021). In his systematic review related to teaching and learning during the COVID-19 pandemic, Vijayan (2021) strongly suggested that future instructor education programmes should integrate technological pedagogy as many have faced a high learning curve in giving fundamental classes during the Covid-19 pandemic period. This is supported by Alonso-García et al., (2019), Garzón-Artacho et al., (2021) and Li et al., (2019), which found that instructors must undergo hands-on experiences training involving the acquisition of new technological skills and pedagogical tactics to improve their professional competency in the educational environment, and thus direct education toward these sustainability principles.

Early evidence provided by Wardoyo et al. (2021) proves that an improvement in students learning outcomes can be achieved through a good understanding of technology by students, high educator competence and good computer skills. When compared to practical skills, the implementation of ICT among VET students is more effective at developing cognitive learning (Yasak & Alias, 2015). However, no correlation has been found between the cognitive dimension of learning objectives and the level of knowledge about teaching techniques (Yousef & Sumner, 2021). According to The Digital Competence Framework, key components of digital competence are identified in five areas: information literacy; communication and cooperation; creation of digital content; security; and problem-solving (Alessandro Brolpito, 2018; European Commission, 2022). These conditions place critical demands on VET stakeholders to train and reskill future and active VET instructors for the ever-evolving technological needs of teaching and learning.

1.3 Gamification and Game-Based Learning (GBL)

According to the International Labour Organisation (2020), six digital learning areas offer great benefits for VET: distance learning and assessment, simulation, flipped classrooms, gamification, open education (resources) and personalisation. BlueWeave Consulting reported that the global education gamification market reached $697.26 million in 2020 (Blueweave, 2021). By the end of 2027, it is expected to expand at a CAGR of 29.00 per cent, bringing in revenue of approximately USD 4.145 billion. The phenomenal expansion of smartphones and mobile devices has directly resulted in the creation of a massive market for gamification. Hence, VET Instructors need to improve digital competency from technologies such as gamification and next-generation digital learning environments (NGDLE) (EDUCAUSE, 2017) to motivate and engage students in purposeful learning activities through the design of the online or situated learning environment (Johnson et al., 2018; Madimabe & Omodan, 2021; Pittaway & Moss, 2014). NGDLE is envisioned as an ecosystem of learning tools and components according to common standards that may be constructed in any way a person or institution desires (EDUCAUSE,

2017). Game technologies are related to the way digital games can be used to facilitate learning, namely game-based learning and gamification.

Gamification is one of several innovative constructivist approaches (Roodt & Ryklief, 2019) to learning that has gained significant attention in recent years in a variety of discipline areas, including commerce, employment, health, the environment, and most recently, our subject of research, education (Manzano-León et al., 2021; Wang et al., 2021). It is defined as "game-based mechanics, aesthetics and game thinking to engage people, motivate action, promote learning, and solve problems" (Kapp, 2012). Generally, everything incorporated in the creation of a game is referred to as a "game element" (Man, 2021), and a wide range of game elements have been used in the design of games. However, Werbach and Hunter (2012) argue that game elements exist in a hierarchy consisting of components, mechanics, and dynamics. They analysed more than a hundred gamification implementations and discovered that a significant proportion of them incorporated points, badges, and leaderboards (PBL). There is, in fact, evidence to suggest that when digital game elements such as avatars, points, badges, and leaderboards are used to achieve specific learning goals and engage students on emotional, social, and cognitive levels, they are more likely to enjoy the learning process (Gupta & Goyal, 2022). However, designing successful gamification applications in education that influence positive behaviour changes is still a riddle (Dichev & Dicheva, 2017). For gamification to be effective, individual game elements must be linked to particular behavioural, motivational, or attitude results, which must then be related to learning outcomes (M. Ma & Oikonomou, 2017). A failure to establish the connection may result in unsuccessful gamification initiatives.

Game-based learning (GBL) is the union of educational learning theories, course curricula, and digital gameplay with the goal of enhancing the learning experience (Jayasinghe & Dharmaratne, 2013; Roodt & Ryklief, 2019). The concept of GBL is fun learning through doing/playing and specifically designed, structured game learning materials which can stimulate the development of thinking skills and self-learning among vocational students (Azizan et al., 2021). Serious games are the most common type of GBL used in education which focuses on the development of games with specific educational purposes in mind (Anastasiadis et al., 2018; Games & Carvalho, 2022), leading to increased enthusiasm for gaming and academic performance (Zhonggen, 2019). A serious game is a computer-based program that is designed for both entertainment and learning purposes by simulating real-world scenarios (Kapp, 2012) and demonstrates remarkably more effectiveness than non-serious game-based learning (Zhonggen, 2019). Dimitra et al. (2020) identified seven main types of GBL approaches implemented in education: (i) memory games, (ii) simulation games, (iii) interactives, (iv) quiz games, (v) puzzles, (vi) strategy games and (vii) reality testing games. There is a body of research that has focused extensively on the overall impacts of GBL, including improved motivation, engagement, satisfaction and academic achievement among vocational education students (Arnold et al., 2021; Balakrishnan Nair, 2021; Oliveira et al., 2021; Roodt & Ryklief, 2019). However, GBL is not widely used in vocational institutions' practice (Arnold et al., 2021), and measures are required to enhance the skills and knowledge

of VET instructors, illustrate and contextualise the influence of game components in the classroom, and make suggestions for game features.

Gamification and GBL is an innovative technology which is considered a leading trend in education. Both technologies may seem similar, but they are two distinct techniques with multidimensional relationships (Jayasinghe & Dharmaratne, 2013; Krath et al., 2021). GBL and gamification are different as GBL incorporates games seamlessly into the educational curriculum to achieve specific learning outcomes. On the other hand, GBL Gamification involves turning the whole learning process into a game using game elements, for example, levels, points, badges, leaderboards, avatars, quests, social graphs, or certificates (Krath et al., 2021). Despite this, the border between GBL and gamification was rather thin at times, especially when both have relatively comparable goals. Both GBL and gamification aim to solve a problem, encourage participants, and increase learning via the use of game-based ideas and tactics.

There are a variety of publications on gamification and GBL in education and professional training nowadays. Each publication focuses on certain issues, elements and technological tools. Saleem et al. (2022), conducted a literature review to determine the advantages and challenges of gamification applications in e-learning and indicated that gamification can be a valuable tool for gaining knowledge and can improve necessary capabilities such as decision-making, cooperation, and communication. However, gamification in educational activities faces multiple difficulties, such as technological infrastructure, internet service provision, and the intention of both students and teachers to use this tool. Behl et al. (2022) used bibliometric analysis and PRISMA to present an examination of the emerging trends of gamification and e-learning for young learners and highlighted the four major future research themes of personalisation, game elements, learner styles, and learner engagement. There are reviewed studies that investigate the effect of gamification in certain fields such as mathematics (Y. Pan et al., 2022), computer science (Willert, 2021) and economics (Platz, 2022). In fact, companies are also turning to gamification to make work more meaningful and fun for their employees. Mahat et al. (2022); Tay et al. (2022) conducted a systematic literature review to examine the influence of gamification and digital GBL on professional training and upskilling over the past five to ten years, while Thomas et al. (2022) analysed 34 articles on gamification in Human Resource and Development and identified four areas where gamification has been studied: employee learning, task performance, employee wellness, and rising contexts.

However, the scarcity of research on gamification and GBL in the VET sector makes it difficult to demonstrate the impact of both techniques (Jayalath & Esichaikul, 2020). Therefore, this research will conduct a systematic review of studies on both gamification and GBL in the VET sector for the last five years. In performing this review, this study aimed to address the following research questions listed below to recognise the emerging trends and situations within the area of gamification and GBL in vocational education during the last five years, as well as to identify the most effective educational gamification or GBL projects and how to duplicate them in future research.

RQ1: What is the distribution of the studies that examine gamification and GBL for the VET sector from 2018 onwards?
RQ2: What is the educational level where gamification and GBL are most studied?
RQ3: What are the research techniques used to examine gamification and GBL for the VET sector?
RQ4: What are the geographical distributions of publication on both methods for VET programmes worldwide?
RQ5: What is the field of VET research addressed in the study?
RQ6: What are the theories and frameworks discussed in the reviewed studies?
RQ7: What is the game technology mostly used in the reviewed study?

The next section of this paper explains the methodology employed. The third section presents the results of the reviewed studies with reference to the research questions. Finally, practical applications and future research directions are suggested in the discussion section.

2 Method

This paper presents our systematic literature review performed using the PRISMA guidelines (Page et al., 2021). We followed the PRISMA standards (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guided by the PRISMA 2020 checklist (see Fig. 1) to highlight scientific validity and provide an unbiased analysis to summarise the evidence on GBL and VET learners. Systematic reviews are a scientific technique of synthesising all relevant publications and documents to answer a specific research question with minimal systematic error (Mengist et al., 2020; Roberts, 2006). It concentrates knowledge on particular subjects and identifies areas of uncertainty and prospect fields where little or no relevant study has been conducted, and future additional research is required. The main purpose of our study was to investigate how far academic research on gamification and GBL in VET has progressed and to identify gaps suited for future research. In the present study, the systematic search strategy comprised three major processes: identification, screening, and eligibility.

2.1 Identification

This phase consisted of a searching and delivery strategy, which assisted in defining a suitable search string and identifying relevant databases to compile the studies to be analysed in the systematic review. The literature search was conducted until February 2022 using four widely renowned databases: a) Scopus, b) Web of Science, c) Science Direct, and d) PubMed, as shown in Table 1. The specific search strings were developed in accordance with each database's search logic while preserving the same terminology. A manual search was also performed using similar keywords on Google Scholar to include citations not included in other databases

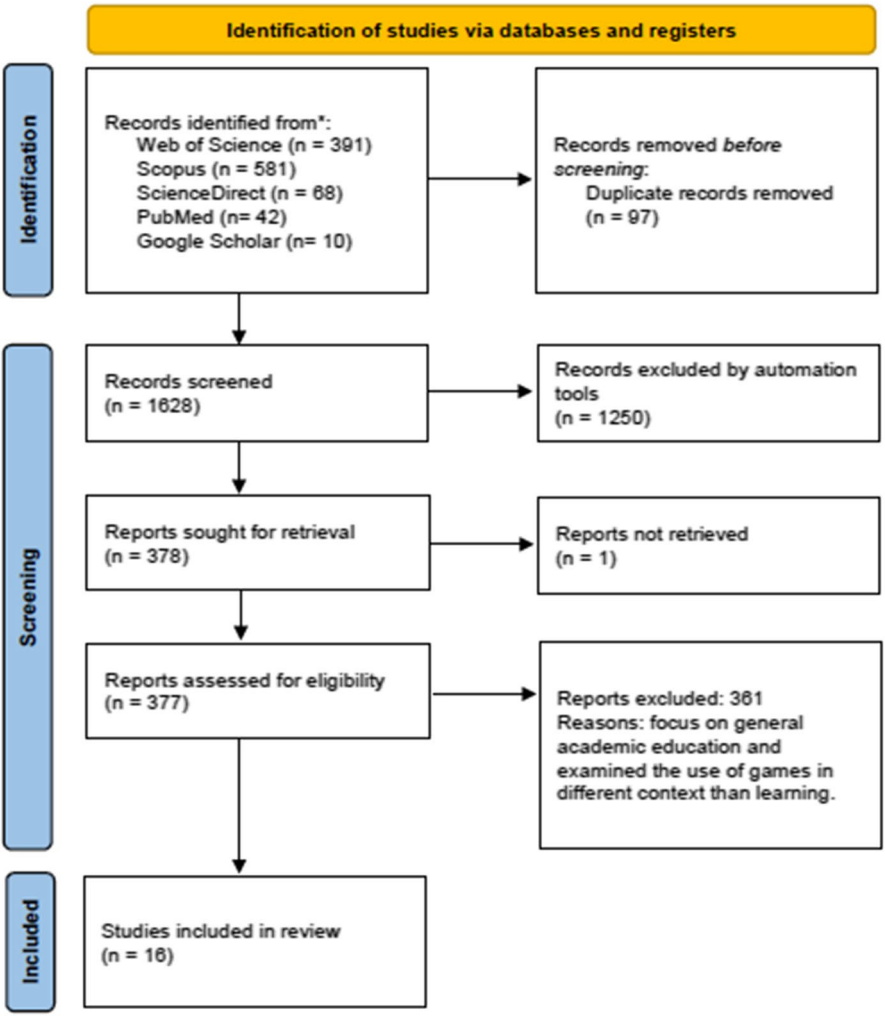


Fig. 1 PRISMA 2020 flow diagram for systematic reviews using a template from Page et al. (2021)

which generated an additional ten articles. There is a gap in the academic literature that includes articles on gamification and GBL in VET. Thus, a total of 1092 articles were gathered in the first stage of the systematic review process. The results were then exported to a table in an Excel sheet for the record. After importing the results, a feature of MS Excel was used to eliminate duplicates automatically. Overall, 97 articles were removed due to duplication, and the remaining 995 articles were then reviewed in the screening stage.

Table 1 Distribution of retrieved papers among sources and search strings

Database	No of Records	Search String
Scopus	581	TITLE-ABS-KEY (gamif* OR game*) AND (e-learning) AND (TVET OR vocational OR "Career and Technical Education" OR "Further Education and Training" OR "Vocational and Technical Education" OR "Vocational Education and Training" OR "Technical and Vocational Training" OR "Apprenticeship Training" OR "Business, Technical and Vocational Education and Training" OR "Professional and Technical Training" OR "Education and Training Technical and Professional")
Web of Science	391	TS = (game* OR gamif*) AND TS = (TVET OR vocational OR "Career and Technical Education" OR "Further Education and Training" OR "Vocational and Technical Education" OR "Vocational Education and Training" OR "Technical and Vocational Training" OR "Apprenticeship Training" OR "Business, Technical and Vocational Education and Training" OR "Professional and Technical Training" OR "Education and Training Technical and Professional")
Science Direct	68	(Gamification OR game) AND (TVET OR "vocational training" OR "Career and Technical Education" OR "Vocational and Technical Education" OR "Vocational Education and Training" OR "Technical and Vocational Training" OR "Further Education and Training")
PubMed	42	((gamif*)[Title/Abstract] OR (game*)[Title/Abstract]) AND ((TVET[Title/Abstract] OR vocational [Title/Abstract] OR "Career and Technical Education"[Title/Abstract] OR "Further Education and Training"[Title/Abstract] OR "Vocational and Technical Education"[Title/Abstract] OR "Vocational Education and Training"[Title/Abstract] OR "Technical and Vocational Training"[Title/Abstract] OR "Apprenticeship Training"[Title/Abstract] OR "Business, Technical and Vocational Education and Training"[Title/Abstract] OR "Professional and Technical Training"[Title/Abstract] OR "Education and Training Technical and Professional"[Title/Abstract]))
Google Scholar	10	(gamif* OR game*) AND ("e-learn*") AND (TVET OR "Technical and Vocational Education and Training" OR "vocational education" OR "technical education")
Total	1092	

2.2 Screening

The goal of screening is to remove irrelevant articles. The remaining 1628 articles were reviewed according to inclusion and exclusion criteria determined by the researchers (see Table 2). The first phase consisted of the screening of titles and abstracts of the studies to identify and label the studies as 'included' or 'excluded' in the table according to the inclusion and exclusion criteria. Educational technology has rapidly changed every facet of our society, so to avoid including outdated content in the review process, the article search was restricted to those which were published between the years 2018 and 2022. This was further validated by earlier literature reviews that concentrated on five-year review intervals to produce results relevant to the most recent research gaps (Anil Yasin & Abbas, 2021; Behl et al., 2022; Mahat et al., 2022; Manzano-León et al., 2021; Rohan et al., 2020). Furthermore, only the documents classified as Article and Review and limited to documents with full text available published in English-language studies were included. Moreover, to meet the research objectives, only articles published within the scope of gamification, GBL and VET were selected (see Table 1). The screening process resulted in 378 articles considered for the third stage.

2.3 Eligibility

A systematic review's third stage is determining eligibility, which necessitates the researcher to conduct an in-depth manual evaluation of all relevant papers based on the main topics of the research. Studies were included if they described gamification and GBL applied to VET. All studies that met the inclusion criteria were independently evaluated by three reviewers. A total of 362 articles were omitted from the database due to their emphasis on general academic education. Several articles were also omitted since the research articles examined the use of games in a variety of contexts rather than specifically for learning. To ensure the review of the field's research is comprehensive, we have opted to add theoretical works on gamification and GBL in vocational education too. This resulted in a total of 17 articles available for review in the subsequent stage (see Fig. 1). However, designing successful gamification apps in education that can sustain the desired behaviour changes is currently more of a guessing game than a science.

2.4 Data Extraction and Analysis

The remaining 17 articles were examined and analysed to provide answers to the posed research questions. The abstracts of the studies were examined in detail, followed by in-depth reading of the entire article to find the most relevant analysis categories. MS Excel was used to categorise key data elements, such as (1) type of publication; (2) context; (3) location; (4) field of study; (5) methodology; (6) sample size; (7) theoretical/concept framework; (8) game design; (9) technology utilised; (10) analysis, and (11) result.

Table 2 Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Timeline	2018–2022	< 2018
Document Type	Article and review	Conference paper, doctoral thesis, books, book chapters and series
Publication Stage	Final	Article in press
Language	English	Non-English

3 Result

This section reports the findings of 17 studies published on gamification and GBL for VET from 2018 to 2022, as systematised in Table 3. This section provides the answers to the research questions that had been proposed earlier to identify the current progress of this study.

3.1 Publication Distribution and Educational Level of the Studies.

The study approach placed a year constraint, requiring only publications published after 2018, in order to gather the most recent research on gamification and GBL for VET programmes. Figure 2 illustrates the evolution of the number of chosen published papers over time and by educational level. The amount of research on gamification and GBL in the VET sector has expanded dramatically from 2020 and beyond, demonstrating a rising interest in this strategy for enhancing student motivation, engagement, satisfaction, and academic success. Furthermore, this finding implies that the impact of gamification and GBL in VET is a growing study area. In terms of the distribution of publications by educational level, as shown in Fig. 3, most of the publications were discovered to focus on vocational school or college, accounting for 76 per cent of all publications, followed by 18 per cent for professional training. Only six per cent of the studies involved samples from both a vocational school/college and a working professional.

3.2 Research Techniques used to Examine Gamification and GBL for the VET sector

Scientific research is often divided into two classes: conceptual research and empirical research. There can be no meaningful research outcomes until there is an idea driving the collecting of data or "evidence", and without a concept, there can be no meaningful research results. Unlike theory-based research, empirical research relies on actual experiments. There are thirteen studies (76%) identified as empirical research, and four articles (24%) were identified as conceptual research (see Fig. 4).

Table 3 Reviewed Studies on Game-Based Learning on TVET Sector

No	Source	Context	Theories/ Frameworks	Game Design	Data Collection	Sample	Result
1	Garcia-Iruela et al., (2021)	Gamified computer systems course using three methodological approaches (teacher-centred, student-centred, and mixed) for 9 month (3 months each) throughout a program of study	Nil	Gamified LMS—Moodle with GameMo plug-in	Quantitative (result data from system)	37—first year of dual vocational training students—from high school, from intermediate vocational training, from the university and from the labour market	Positive
2	Kladchuen and Srisomphan, (2021)	Synthesize problem-based learning model in conjunction with the gamification concept to enhance high-level vocational students' problems-solving skills (PBLGPS-LMS online system)	Nil	Using problem-solving skills to complete planned missions in the city map activity through the game application	Synthesis of documents and research, focus group	Synthesis – 29 papers FG – 9 experts	Nil
3	Kummanee et al., (2020)	Analyse, design, and evaluate digital learning ecosystem involving STEAM gamification to develop a vocational innovator	Nil	Design five STEAM Gamification and five gamification elements	Synthesis of documents and research, focus group	FG – 7 experts	Nil

Table 3 (continued)

No	Source	Context	Theories/ Frameworks	Game Design	Data Collection	Sample	Result
4	Wang and Khambari, (2020)	AR-based gamified English course in vocational college	interest-driven creator (IDC) theory	AR mobile technology called Easy AR platform to master the English sentence expression regarding the campus building	in-depth interviews	50 vocational students participated in vocational college of China	Positive
5	Wang et al., (2021)	AR-based gamified English course in vocational college	interest-driven creator (IDC) theory	Gamified AR mobile application, called XploreRAFE + +	observations, focus group, individual interviews, and document analysis	38 students involved, majoring in preschool education at vocational college of China	Positive
6	Jayalath et al., (2022)	Operational model and gamification design of blended electronic circuits course, which embed motivational and engagement designs in TVET	self- determination theory (SDT), ARCS Motivational Model	Gamified LMS—Moodle LMS with fifteen game dynamics, relevant mechanics, and appropriate game components	a focus group, pre and post-test assessment, Practical labs session and assessment, online questionnaire	undergraduate level—control group and the experimental group	Nil
7	Ma et al., (2021)	Effect of theme games and scenario simulations on the disaster nursing competence of nursing students	Flow theory and ICN Framework of Disaster Nursing Competencies	Theme game called "Brave the Wind and Wave" played in a simulated training room	randomized controlled study compared pre-test and post-test results	104 sophomore nursing students	Positive
8	Habes et al., (2020)	Gamified training on the geriatric knowledge of nurses and nursing students	Nil	Video-based gaming and storytelling tool called Serioussoap.nl	explorative pilot study, combined a pre-test post-test quantitative design, with a qualitative approach	290: vocational nursing schools /university and 44: home-care organization	Positive

Table 3 (continued)

No	Source	Context	Theories/ Frameworks	Game Design	Data Collection	Sample	Result
9	Wouters and Van Der Meulen, (2020)	Investigate whether learning styles influence game-based learning for proportional reasoning topic in prevocational secondary education	Felder and Silverman Learning Styles Model	"Zeldenrust"—a cartoonlike 2D game developed in Flash/ ActionScript 3 that can be characterized as a combination of a simulation game and a role-playing game	Pre-test and post-test and questionnaire	108 participants from 2nd/3rd -year prevocational education	Negative
10	Tongpaeng et al., (2019)	Employing the cognitive theory and interactive media to improve the learning performance of knowledge workers who are working in the tourism industry	cognitive load theory	2D learning game right after watching the learning video consisted of a PowerPoint lesson in an online learning system	Pre- test and post-test design	64 knowledge workers in front office positions from hotels in Chiang Mai, Thailand	Positive
11	Balakrishnan Nair, (2021)	Explore role and benefits of game-based learning activities in tourism higher education in the context of COVID-19-induced disruptions	gamification theory	online quiz games	combination of semi-structured interviews, online questionnaires, and participant observation	survey: 56 interview: 25 undergraduate students majoring in tourism and hospitality	Positive

Table 3 (continued)

No	Source	Context	Theories/ Frameworks	Game Design	Data Collection	Sample	Result
12	Lerner et al., (2020)	VR simulation training for emergency medical services personnel's a complement to traditional simulation training	Nil	EPICSAVE (Enhanced Paramedic Vocational Training with Serious Games and Virtual Environments) project, a highly immersive room-scaled multi-user 3-dimensional VR simulation environment	Experimental studies-cross-sectional, one group pre-test and post-test design	18 participating emergency physicians from the Clinic of Anaesthesiology of the Heidelberg University Hospital	Positive
13	Azizan et al., (2021)	Game-based learning for vocational students in automotive air-conditioning course to increase students' motivation and achievement	Nil	online game platform, Quizizz. The game design contained several modules such as learn, flashcard, quiz, gravity, and match	quasi-experiment—pre-test and post-test and questionnaire	30 Refrigeration and Air-Conditioning Technology course students' vocational college	Positive
14	Roodt and Ryklief, (2019)	Digital game-based learning on computer programming concepts to improve the academic efficiency among vocational education students in South Africa	Constructivist theory, ARCS Motivational Model	"Millionaire Programmer" and developed using the web application	Mixed Method—pre- and post-intervention tests and post-intervention questionnaire	50 vocational education learners studying computer programming	Positive

Table 3 (continued)

No	Source	Context	Theories/ Frameworks	Game Design	Data Collection	Sample	Result
15	Bernal et al., (2022)	Power substation operational training by exploring and interacting with realistic models in virtual worlds using serious games	Building information modelling (BIM)	Virtual Reality—cave automatic virtual environment (CAVE)	Questionnaire	six postgraduate students of a VR course and 16 substation technicians	Positive
16	Hämäläinen et al., (2018)	Create productive knowledge construction among players through collaborative game mechanics	Nil	Game Bridge: a three-dimensional (3D) collaborative serious game	Mixed Method	15 vocational school students	Positive
17	Glover and Bodzin, (2021)	Learner-centric design of a hand hygiene serious simulation game for grade 12 emerging health professional students training	Expectancy-Value Theory of Achievement Motivation, the Expert Performance Theory and Self—Determination Theory (SDT)	Hand Hygiene Serious Simulation Game (HH-SSG) played within the physical space of a simulated hospital room	Mixed Method – survey, semi-structured interviews	non-game-oriented grade 12 female CTEEHP students from 6 racially and economically diverse north-eastern U.S. high schools, as well as the selective CTE EHP program	Nil

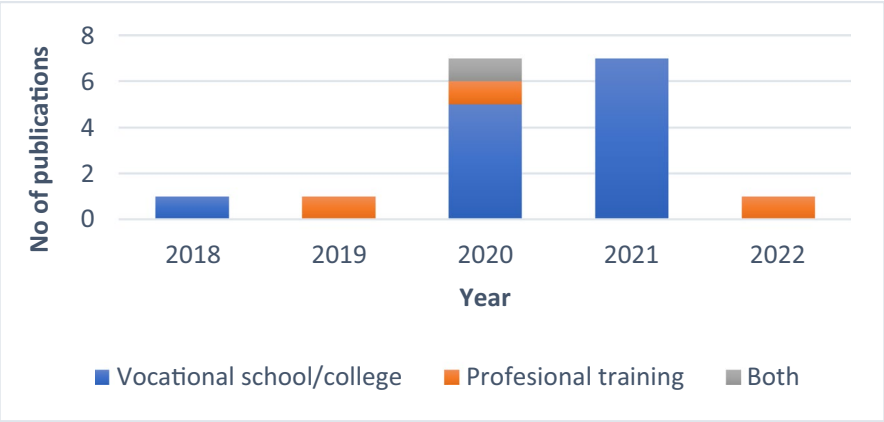
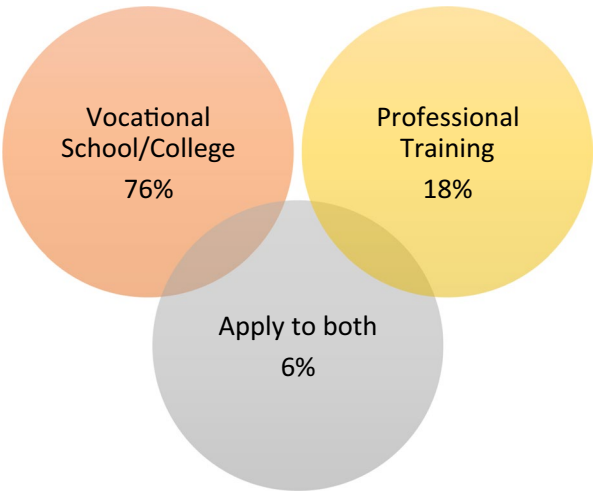


Fig. 2 Number of selected published articles per year/education level

3.3 Geographic Distribution of Scientific Contribution

The geographical distributions of the data sources for reviewed publications are shown in Fig. 5. Research on gamification and GBL for VET has been conducted the most in Asian countries (53%, N = 9), followed by European (29%, N = 5), South American (6%, N = 1), North American (6%, N = 1) and African (6%, N = 1). Surprisingly, no study has been conducted in Oceania. Thailand was the top country in Asia for publishing research in the context of gamification and GBL for VET (N = 4), followed by China (N = 3) and the Netherlands (N = 2). Ireland, South Korea, Germany, Malaysia, South Africa, Columbia, Finland, and the United States contributed to the literature with one study each.

Fig. 3 Percentage of publications distribution according to educational level



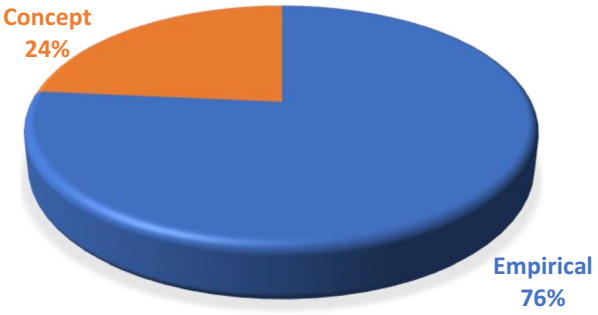


Fig. 4 Scientific research type of reviewed studies

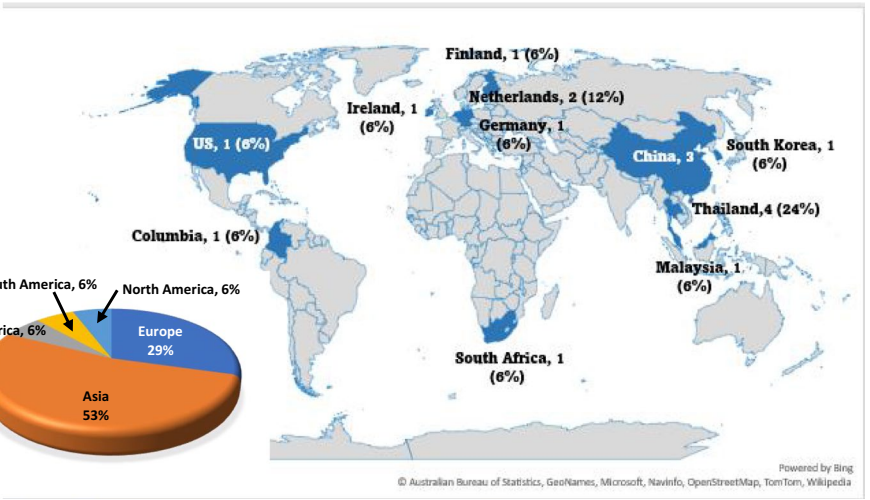


Fig. 5 Continents and countries distributions of Gamification and GBL for VET publications

3.4 Field of Research on Gamification and GBL for VET

Notably, the data indicated (see Fig. 6) that the most often published articles on gamified vocational education and training (29%, N = 5) are in the fields of computer (N = 2), electrical (N = 1), electronic (N = 1) and automotive and air conditioning courses (N = 1), which are categorised as engineering. Nursing and medical-related studies, which are classified as healthcare, are the second-largest category (24%, N = 4), followed by general subjects (18%, N = 3), where English and Mathematics courses were placed. Studies in food service and tourism are in separate categories. Tourism and all other categories published 12% (N = 2) of the articles on gamified vocational education and training. All categories encompassed studies with an unspecified field, where the gamified activities can cover a wide range of professions. The least frequent domain (6%, N = 1) was food service. Considering the above findings, it is possible to verify that gamification and GBL strategies are applied to a broad range of fields and skills.

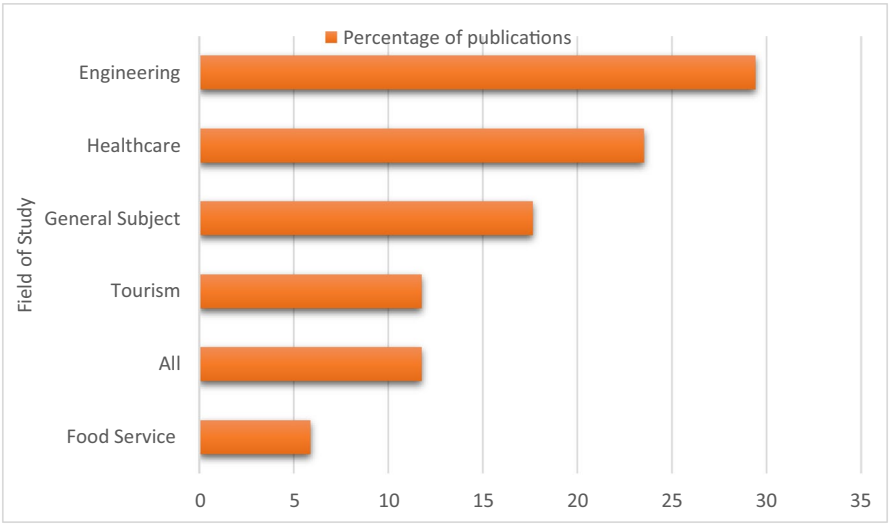


Fig. 6 Distribution of the examined studies across the various training sectors

3.5 Theoretical Foundations or Frameworks of the Reviewed Studies

The lack of theoretical frameworks in practical studies contributes to ineffective measurement (Behl et al., 2022; Roodt & Ryklief, 2019). After synthesising some literature reviews of predecessors, this research found that there is relevant theoretical support for gamification and GBL for the VET sector. The summary of the theories is presented in Table 4. The present literature builds upon ten theoretical perspectives and instructional design models to promote gamification and GBL in the

Table 4 Theoretical Foundation or Framework Employed in the Reviewed Studies

Theoretical Frameworks	Studies
Interest-Driven Creator Theory (IDC)	Wang and Khambari, (2020); Wang et al., (2021)
ARCS Theory of Motivation	Jayalath et al., (2022); Roodt and Ryklief, (2019)
Self-Determination Theory (SDT)	Glover and Bodzin, (2021)
Engagement Theory	Jayalath et al., (2022
Flow Theory	Ma et al., (2021)
ICN Framework of Disaster Nursing Competencies	Ma et al., (2021)
Felder and Silverman Learning Styles Model	Wouters and Van Der Meulen, (2020)
Cognitive Load Theory	(Tongpaeng et al., 2019)
Gamification Theory	(Balakrishnan Nair, 2021)
Constructivist Theory	Roodt and Ryklief, (2019)
Building Information Modelling (BIM)	Bernal et al., (2022)
Expectancy-Value Theory of Achievement Motivation	Glover and Bodzin, (2021)
The Expert Performance Theory	Glover and Bodzin, (2021)

VET sector. More than half of the studies (59%), as shown in Fig. 7, discussed their studies from theoretical perspectives and/or were guided by frameworks. Fewer than half of the reviewed studies (41%) did not discuss any theoretical foundations or frameworks, although most reported a positive impact on motivation, engagement, and training performance. Interest-Driven Creator Theory (IDC), Self- Determination Theory (SDT) and ARCS Theory of Motivation were the most common theories found in the reviewed studies (N = 2). Sometimes multiple frameworks were integrated into the reviewed studies.

For instance, the article by Jayalath et al. (2022) used the ARCS theory of motivation and engagement to design the operational model and gamification design of a blended electronic circuit course using gamified LMS in TVET. Similarly, a randomised controlled study by Ma et al. (2021) compared the effect of theme games and scenario simulations on the disaster nursing competence of nursing students, and used flow theory combined with the ICN framework of disaster nursing competencies as the guiding theoretical framework. Constructivism is probably the learning theory that offers propositions closest to gamification and GBL. Roodt and Ryklief (2019) chose the constructivism approach and configured a digital game application called "Millionaire Programmer" to match the motivational recommendations outlined in the ARCS Model. Glover and Bodzin (2021) developed a Hand Hygiene Serious Simulation Game (HH-SSG) for health professional clinical education by combining multiple theoretical frameworks: Expectancy-Value Theory of Achievement Motivation, Expert Performance Theory, and Self-Determination Theory; and frameworks developed through previous simulation-based learning and serious games research for first cycle coding analysis.

3.6 Game Techniques

Several combinations of technology are used during the application of gamification and GBL for the VET sector. From the reviewed literature, the author identified five game technologies used, as shown in Table 5. Three studies (Garcia-Iruela et al., (2021); Jayalath et al., (2022); Tongpaeng et al., (2019)) employed the Moodle application, which can support MOOC as their learning management system to deliver online courses, while two studies (Kladchuen and Srisomphan, (2021); Kummanee et al., (2020)) designed a problem-based learning model which consisted of a digital learning platform in the early design stage. Four studies used an enriched

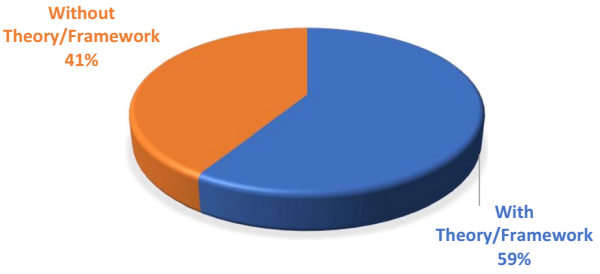


Fig. 7 Total reviewed studies incorporating theoretical foundations/frameworks

Table 5 Technology Employed in the Reviewed Studies

No	Game Techniques	Studies
1	Gamified Learning Management System / Massive Open Online Course (LMS/MOOC)	Garcia-Iruela et al., (2021); Kladchuen and Srisomphan, (2021); Kummanee et al., (2020); Jayalath et al., (2022); Tongpaeng et al., (2019)
2	Augmented Reality/Virtual Reality (AR/VR)	Wang and Khambari, (2020); Wang et al., (2021); Lerner et al., (2020); Bernal et al., (2022)
3	Role Play and Simulation	Ma et al., (2021); Glover and Bodzin, (2021); Wouters and Van Der Meulen, (2020); Hämäläinen et al., (2018)
4	Browser Games	Balakrishnan Nair, (2021); Azizan et al., (2021); Roodt and Ryklief, (2019);
5	Interactive Media	Habes et al., (2020);

experience in the real world and virtual settings in their educational delivery. In two studies (Wang and Khambari, (2020); Wang et al., (2021)), AR technology that combines virtual information with the real world to teach English was used. Another two studies (Lerner et al., (2020); Bernal et al., (2022)) developed serious games using VR and Immersive VR (IVR) technology for professional training in medical centres and power substations.

Four studies were categorised under roleplay and simulation technology. Three studies developed a serious simulation game: (1) Ma et al. (2021) developed a theme game for nursing students called “Brave the Wind and Wave” played in a simulated training room; (2) Glover and Bodzin (2021) developed the “Hand Hygiene Serious Simulation Game (HH-SSG)” for healthcare programme training played in a simulated hospital environment; (3) Hämäläinen et al., (2018) developed a virtual 3D serious game dubbed "Game Bridge" that utilises collaborative game mechanics to promote constructive knowledge production among vocational students. In a different method, Wouters and Van Der Meulen’s (2020) studies used a cartoonlike 2D game called “Zeldenrust”, which can also be characterised as a combination of a simulation game and a role-playing game.

A study by Habes et al. (2020) was classified as interactive media. The authors built an interactive video-based game and narrative experience called "Serioussoap.nl" in collaboration with two young, well-known Dutch soap opera actors in order to better understand the influence of geriatric information on home care nurses or nursing students. (Azizan et al., 2021; Balakrishnan Nair, 2021) They used online quizzes as GBL learning activities in tourism, automotive, and air-conditioning courses, whereas Roodt and Ryklief (2019) used a web application called "Millionaire Programmer" to teach and assess students’ knowledge of computer programming.

Figure 8 illustrates the technology used in the reviewed studies. The majority of the research made use of LMS/MOOC-based gamification (29%). AR/VR, role-playing games, and simulation technology each contributed about 25% of the approaches used in the study of literature. Browser games technology employed 18%

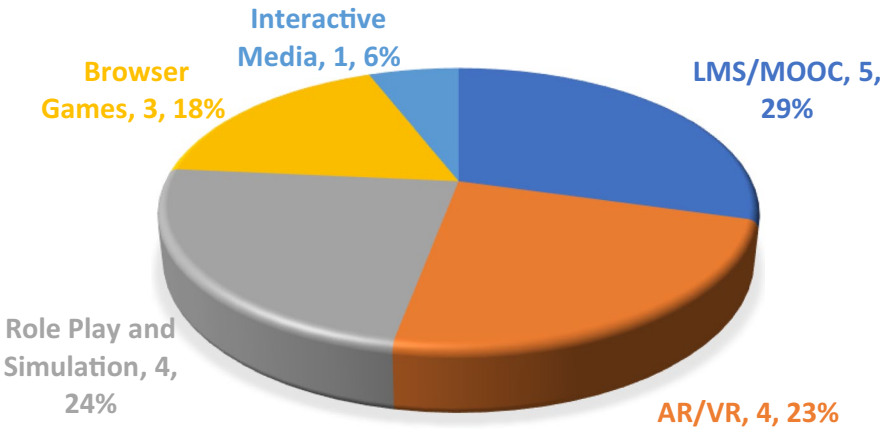


Fig. 8 Percentage of technology employed in reviews studies

of the reviewed literature. The least-used technology was interactive media, which contributed to 6% of the study.

4 Discussion

The movement from traditional to digital learning has increased significantly in 21st-century education. Traditional learning methods are being enhanced with agile, collaborative, and technology-based education. Gamification and game-based learning in vocational education is a growing trend that involves introducing game design aspects into educational environments to increase learners' motivation and engagement. The reviewed studies provide evidence to indicate that gamification and game-based learning has a promising future in vocational education and training. The systematic review identified 17 journal articles from different countries with different contexts and technology.

4.1 Publication Distributions in Time and Educational Level of the Studies

With reference to the distribution of publications on gamification and GBL for VET, the reported findings indicate that since 2020, gamification and GBL in vocational education and training have been a vibrant and rapidly rising topic of study, with an ever-increasing level of interest. We can see a surge in the number of publications between 2019 towards 2020 and onwards. This is probably because most of the current evidence supports the use of gamification and game-based learning as a powerful tool for improving and enhancing the quality of teaching and learning in vocational education due to the difficulties and disadvantages of conventional classroom instruction (Chan & Lo, 2022; Gupta & Goyal, 2022; Rodrigues et al., 2022). In addition, a growing number of vocational institutions including community colleges, polytechnical institutes, apprenticeship institutes, and vocational training schools are striving to expand their reach beyond geographical and social barriers where modern game-based learning platforms are specifically designed to suit all types of learning environments and provide students with access to the most favourable educational and job opportunities (The World Bank Group, 2021).

Competency-based education (CBE) is developing as a viable approach for educating students for global competence. However, the emergence of educational gamification approaches in the sector of vocational education was slower than in the academic field, where the topic of gamification has blossomed and expanded dramatically since 2013, with hundreds of relevant papers released each year (Charlo et al., 2022). The reason for this may be due to the fact that instructors in vocational institutions are only moderately prepared to use the gamification approach due to their lack of experience and time in developing gamification-based applications and preparing teaching and learning materials, and their lack of knowledge of ICT (Omar et al., 2022). Hence, it is crucial for TVET instructors to have the pedagogical competence to match training with the used modality. Skilled instructors/trainers are essential for assuring quality and sustaining training standards, which

improve the employability of students. The graph shows a reduction during the final year (2022), but since many publications are still in the process of indexation in the databases, it cannot be said that interest in the topic has already passed its peak. In support of this, O'Neill (2022) reported that game-based learning and education have been predicted to generate revenue of more than USD24 million by 2024. This demonstrates that gamification and GBL are useful delivery strategies for vocational training and upskilling, and their use is expected to increase.

Considering the educational level, the most significant number of studies in the survey period were conducted at vocational schools or colleges (13 papers), with less attention to professional training (3 papers). Only one research makes use of both sample populations. A possible explanation for this disproportion is that there are a large variety of accessible game-based platforms and applications on the web market that integrates different engagement elements, making them easier for vocational educators to explore/experiment with their learners. With the advent of the internet, mobile applications, and gamification, educational activities have evolved into e-learning to facilitate learning and make it an entertaining experience. Some of the most popular gamified apps in the educational sector are Gimkit, BookWidgets, Edmodo, iSpring, Scratch, Kahoot, Quizlet, Plickers, Genially, Articulate 360, H5P, Thinglink and many more. While there are over thousands of educational web apps available, choosing the right ones for students will make them enjoy learning. To achieve this, the instructor must be technologically savvy or possess the requisite computer-related abilities to apply the GBL. However, there is a lack of comprehensive research devoted to the development of TVET instructors' digital competence in using a range of educational technologies, particularly gamification and GBL, in professional activities, which allow contributions to the formation of professional competencies among students. Thus, further research on developing the digital competence of TVET instructors in various educational technologies by employing hands-on professional training, particularly in using gamification and GBL in professional activities, is necessary.

It can be acknowledged that studies including diverse demographic groups are helpful, as we cannot always generalise the results of research involving one demographic group to another. In the literature review on gamification prospects in industry 4.0, Reis et al. (2020) assume that the possibility of research limits for professional training is attributable to the fact that many firms do not transfer the outcomes of adopting gamification into the scientific database. This suggestion is backed up by the Gartner analysis, indicating that more than 70 per cent of the Global 2000 organisations have already used gamification (Softek, 2017). However, it remains unclear if most of the firm's emphasis on professional training is connected to the TVET industry. Based on a review study by Mahat et al. (2022), education is not the most common field for gamification in professional training, since research on gamification in education has mostly focused on students and adults rather than instructors. Nevertheless, since the primary objective of vocational education is to prepare graduates for employment, it must include specialised training that tends to be creative-reproductive in accordance with industry requirements. In addition, it is essential to determine TVET instructors' perceptions, readiness, and competence skills to embrace the gamification and GBL strategy. Therefore, future research agendas

should prioritise the development of additional empirical studies that confirm gamification and GBL's usefulness for professional training in the vocational education sector, and this should include educating TVET instructors by providing them with hands-on gamified professional training experience.

4.2 Research Techniques and Countries Distributions

From the reviewed articles, 13 studies (76%) were identified as empirical research, and four articles (24%) were identified as conceptual research (see Fig. 4). Since gamification and GBL are relatively new concepts in the VET sector, the amount of research is very limited, especially in experimental studies. Two conceptual research (Kladchuen and Srisomphan, (2021); Kummanee et al., (2020) synthesis of previous research documents constructed a problem-based learning management model in connection with the gamification technology in a digital learning environment to produce a vocational innovator. Meanwhile, Jayalath et al. (2022) presented a thorough design and operational model for gamified blended learning courses in TVET with the goal of increasing motivation and participation. Additionally, Glover and Bodzin (2021) reported a learner-centric design of a hand hygiene simulation game built for non-game-oriented grade 12 female CTE EHP students based on the results of two learner studies. Future empirical studies on gamification and GBL in the TVET sector should therefore be conducted to generate more results.

The presented results indicate that the Asian continent contributed the most publications on gamification and GBL for VET (53%, N = 9). Although Thailand leads the research, it is not dominated by a single country or group of countries, as published works in the research area are extremely limited, and only three countries (Thailand, China, and the Netherlands) contributed slightly more studies than the remaining thirteen countries. However, this finding is consistent with the gamification education market report, which indicates that Asia–Pacific is predicted to develop at the highest pace during the forecast period, owing to increased education sector investments in countries, which is boosting the worldwide education gamification market in APAC nations (Market Data, 2022). This region's fast-rising economies are also focused on closing the skilled labour supply–demand imbalance, where several initiatives are being developed to boost technical sector VET and enhance discretionary income (Meticulous Market Research, 2022). It is anticipated that these actions would enhance vocational education and expand market prospects for major firms in this region.

The worldwide education gamification market is classified geographically into North America, Europe, Latin America, Asia–Pacific, the Middle East and Africa, and the rest of the globe. North America accounted for nearly 37% share of the global gamification in the education market in 2018 and is expected to dominate the market throughout the forecast period (Market Data, 2022). Technavio analysts forecast the technical and vocational education (TVE) market in North America to grow at a CAGR of 4.13% during the period 2016–2020 (Technavio, 2016). However, North America contributed only one publication on the reviewed studies. This is probably because the importance is given to the region's widespread availability

and penetration of digital services rather than publications on journal databases. It would be useful to investigate how developed countries embraced gamification and GBL in their vocational education sector, especially in the technology innovation of The Industrial 4.0 revolution. As a result, future research on gamification and GBL in the TVET sector should be undertaken across cultures more extensively, as various organisations and geographical regions may provide different findings.

4.3 Field of Study

The collection of papers is divided into five sections and covers a wide variety of occupational fields. Gamification and GBL can be applied in any industry, yet the engineering field seems to generate the most articles on gamification and GBL in VET. This is likely because the diverse range of engineering field courses includes subjects that are more closely related to technical abilities. In the literature review on the role of gamification in engineering education, Anil Yasin and Abbas (2021) indicated that gamification strategy using electronic-based gamification tools or digital gamification is more effective and an improvement over traditional teaching methods. However, most engineering disciplines require a minimum of seven years of formal study to achieve an average level of technical proficiency, while a vocational type of education is designed to produce "job-ready" industrial workers at all levels from entry to management. In a professional setting, students learn how to apply their knowledge in a real-world context, allowing them to step immediately into the workforce and begin their careers.

Gamification in healthcare, too, is gaining momentum as the industry is experiencing challenges that have prompted medical institutions worldwide to adopt modern technologies and become more user-centric to better cope with stakeholders' increasing demands and needs. Three studies on healthcare (Ma et al., (2021); Lerner et al., (2020); Glover and Bodzin, (2021)) used serious simulation game training to enhance the quality of healthcare training, while one study by Habes et al., (2020), conducted an explorative pilot study to examine the effect of developed gamified video storytelling on the geriatric knowledge of nursing students and home-care nurses. Another interesting observation is the use of GBL in general subjects (English and Mathematics) on vocational education learners (Wang and Khambari, (2020); Wang et al., (2021); Wouters and Van Der Meulen, (2020)). Additionally, this positive finding will assist with the overcoming of numerous obstacles during this learning process since most vocational learners are more competent in practical learning. The food service and tourism industry is a service industry which emphasises experiences co-created by customers or tourists and service providers very much. From the reviewed literature (Hämäläinen et al., (2018); Tongpaeng et al., (2019); Balakrishnan Nair, (2021)), it can be concluded that the food and tourism industry may also employ gamification and GBL as an external marketing, sales, and customer engagement tool, as well as an internal training and productivity tool (Pasca et al., 2021; Xu, 2013). Nonetheless, only a small number of researchers have investigated these topics in the TVET sector, although vocational education is a lifelong education comprised of a wide variety of fields that focus on developing the skills of adults and responding to the labour-market needs of the economy. Therefore, additional studies should be performed to

examine the applicability of gamification and GBL in diverse domains of vocational education and to determine their effectiveness.

4.4 Theoretical Framework

This systematic literature review showed that studies on gamification and GBL for VET have so far used a variety of 12 different theories. Over half of the assessed studies employed at least one theoretical framework as a guide. Table 4 outlines all the theories mentioned in the analysed reviews, together with the total number of primary research studies conducted based on each theory. In scientific research, gamification or GBL design may be described using several theoretical foundations, including motivation, behaviour, or learning theories (L. Pan et al., 2021). The most recognised quality of gamification and GBL is their motivating value. Most of the studies evaluated are concerned with motivational effect, including ARCS theory of motivation, expectancy-value theory of achievement motivation, flow theory and self-determination theory. Engagement theory, interest-driven creator theory, Felder and Silverman's learning styles model and expert performance theory describe the determinants of behavioural outcomes, while constructivist theory and cognitive load theory are theoretical foundations that deal with the processes of learning. The ICN framework of disaster nursing competencies and building information modelling propose guidelines for system design. The majority of the theoretical foundations examined in the research effectively demonstrated a beneficial effect on vocational learning through gamification and GBL. However, there is minimal consistency regarding theoretical foundations and the scope of gamification (Seaborn & Fels, 2015).

4.5 Game Techniques

Emerging technology can help instructors better apply gamification and GBL in the information age. Various combinations of gamification and GBL technology in vocational education and training were also identified, including the use of technological advancements in education 4.0 such as big data analytics, augmented reality (AR) /virtual reality (VR), cloud computing and simulation (Halili, 2019). Although the majority of the literature review (N = 5, 29%) made use of gamified LMS/MOOC technology, three studies (Jayalath et al., 2022; Kladchuen & Srisomphan, 2021; Kummanee et al., 2020) consist of theoretical papers with no empirical data supporting the proposed design of educational learning environment system. More studies on how LMS/MOOCs will evolve in the VET sector seem to be an interesting subject of research.

4.5.1 Learning Management System (LMS)/Massive Open Online Course (MOOC)

Recent years have seen a rise in the popularity of online learning management systems based on MOOCs, particularly during the COVID-19 pandemic period. However, there are also well-known downsides of MOOCs, such as a lack of student motivation,

student involvement, and high dropout rates that call the effectiveness of MOOCs into question (Rohan et al., 2020; Seaborn & Fels, 2015). Some LMS/MOOCs just imitate traditional teaching methods by including multimedia features like video lectures in their courses. Others go a step further, seeking to maintain the interest of the exceptionally high number of course participants by combining modern technology with educational paradigms. Gamified LMS/MOOCs can raise the motivation of participants to handle the challenge tasks with game mechanics, game dynamics, and components and impact higher involvement, improve user experience, and ensure the loyalty of students, which may lead to a bigger number of proactive participants. A systematic review conducted by Muangsrinoon & Boonbrahm (2019) proves the wide variety of game elements, retrieving a total of fifteen terms of game elements from twenty-two selected papers that were screened from a total of eighty-two documents. However, only a few terms are commonly used: points, feedback, levels, leader boards, challenges, badges, avatars, competition, and cooperation. From the author's search of the literature, four studies (Garcia-Iruela et al., 2021; Jayalath et al., 2022; Kladchuen & Srisomphan, 2021; Kummanee et al., 2020) included several game elements such as points, badges, levels, leader boards, blocked content, time limit, trophies, virtual goods and spaces feedback and progress bar in the LMS/MOOC to motivate students, increase participation, embark high interest in learning and improve satisfaction.

LMS/MOOC systems often come equipped with a selection of built-in social tools for gamification purposes. For example, Jusas et al. (2022) implemented an Object-Oriented Programming (OOP) course in a Moodle platform, where two additional plugins (H5P and Level up) for experience points and interactive content were employed. Four gamification elements (XP points, interactive content, local team, and global team), which motivate the different students' needs, were introduced into the OOP course. Similar work was also carried out by Garcia-Iruela et al. (2021), which utilised the GameMo plug-in that expands Moodle's capabilities. She investigated three different research methodologies (teacher-centred, student-centred, and mixed approach) to address the issue of low student motivation over three different time periods and discovered that only the teacher-centred and mixed approach produced a positive result. This finding demonstrates that a problem-based learning approach in gamification design increase student engagement and the influence of gamification is context-dependent indicating that future research should focus on LMS/MOOC. Evidence from another reviewed study (Tongpaeng et al., 2019) suggested that implementation of shorter learning videos (below six minutes) and interactive media increased not only engagement, but also the learner's achievement in MOOCs. It should also be noted here that to increase students' satisfaction and solve the high dropout problem in the online learning management system, or MOOCs, educational institutions, educational system designers, and instructors should design learner-centred gamification mechanisms that take students' learning requirements into consideration (Cheng, 2021).

4.5.2 Immersive Reality

The broad and rapid adoption of wireless networks and mobile devices has lowered the barrier to entry for new technologies like Augmented Reality (AR) and Virtual

Reality (VR) and brought major benefits to technologically supported education. Two studies (Wang & Khambari, 2020; Wang et al., 2021) using AR mobile application technology for English learning aimed at vocational college students from China. This is not surprising given that China has entered the big data, network, and intelligent age known as China Education 2025, which focuses on the Industry 4.0 model (WU & SUN, 2017). Both studies indicate an increase in interest, motivation, and engagement because of the immersive setting and meaningful experience gained during the learning process. Additionally, students describe positive relationships and high interactions that occur throughout the educational process.

Another two studies (Bernal et al., 2022; Lerner et al., 2020) used VR and Immersive VR technology in a serious game design for professional training and are from Germany and Columbia. Both studies revealed a favourable effect with a strong sense of immersion and game flow during the session, as well as a positive influence on training effectiveness and training execution quality. Our most intriguing finding is that both VR studies used different strategies to achieve the total immersion experience and collaborative learning in the virtual world. A study by Lerner et al., (2020) used a set of head-mounted displays (HMD) while Bernal et al. (2022) used an immersive virtualisation system called the cave automatic virtual environment, a virtual reality room-sized environment where a user would be experiencing VR by the use of LCD shutter glasses. It was found that using IVR can reduce the limitations of virtual reality headsets for collaborative learning and produce higher learning gains compared to textbook study (de Back et al., 2020).

4.5.3 Serious Game Simulations

A serious game is a computer-based program that is designed for both entertainment and learning purposes by simulating real-world scenarios (Kapp, 2012). It has been experimentally demonstrated that games are indeed a learning method to enhance competency and generate innovative, collaborative learning that emerges from interactive, constructivist, cooperative, and improvisational educational techniques (Hämäläinen et al., 2018; D. Ma et al., 2021). However, a study on the influence of learning style (Wouters & Van Der Meulen, 2020) on games produced a null effect on motivation. Despite this, most of the current evidence supports the use of serious games in educational learning (Barbieri et al., 2021; Glover & Bodzin, 2021), and this includes the development of social and professional skills for people with intellectual disabilities (von Barnekow et al., 2017).

4.5.4 Interactive Media and Browser Games

Daily technology advances and inventions are rapidly being ingrained in our culture. The word "interactive media" refers to media that enables active engagement on the part of the recipient, thus the term "interactivity"(Shahzad & Khan, 2009). According to Habes et al. (2020), adopting interactive media technology boosted knowledge acquisition, meaningful experience, and learning impact for nursing students and home care nurses. In support of this, it has been shown (Nacional et al., 2021) that

the usage of Digital Storytelling in conjunction with stop-motion animation techniques has been a beneficial educational and innovative experience. Alternatively, two studies (Azizan et al., 2021; Balakrishnan Nair, 2021) found that the use of online quizzes in GBL increased students' achievement, engagement and motivation while also stimulating their cognitive abilities and adding value to the learning experience. Additionally, outcomes promote diversity in education and the development of employable skills. Finally, the use of a browser game in the reviewed study increased both motivation and academic accomplishment.

A substantial amount of research has proved the benefits of using gamification in education at the university, high school, and even secondary school levels, but there has been relatively little focus in the literature on vocational education and training (VET). Based on available data, these results have led to high levels of agreement that gamification and GBL enhance good quality and effectiveness of vocational education and training. However, the beneficial effects of gamification and GBL in education also highlight the necessity of instructors' professional development competence building. Instructors must possess knowledge as well as gaming experience, creativity, and resilience, in order to use gamification and game-based learning applications (Araújo & Carvalho, 2022) in an educational environment. It is important for VET instructors to be ready and digitally competent to meet the needs and challenges of today's society by taking into consideration developing trends that are presently present in professional settings and will be present in the future. To address this issue, future research in this area should concentrate on the creation of further empirical studies on the digital pedagogy training model for TVET instructors utilising a range of emerging technologies to evaluate the efficacy of gamification and GBL in vocational education. It is possible that future studies may compare the data analysis from pre- and post-tests with the integration of various game elements and developed technology for experiments into instruction to determine the most appropriate technological pedagogy and game techniques that can be applied in the teaching and learning environment to increase students' active engagement and motivation. It is important for educational institutions, system designers, and instructors to design learner-centred gamification mechanisms that consider student learning requirements and learn from developed countries that have implemented GBL and GBL in their vocational education sector, especially in the Industrial 4.0 revolution.

5 Limitations

This study examined only conceptual and experimental academic studies conducted in selected databases (Web of Science, Scopus, PubMed and ScienceDirect) and a few from Google Scholar, excluding grey literature and book chapters. The language restriction is included, as the papers analysed were in English only, necessitating the exclusion of other publications that may have been included in the study. As a result, there was a possibility of publication bias impairing the systematic review's validity. However, the number of publications in languages other than English is extremely low (<5), and it was not analysed to determine if it might be included in the database. The number of articles reviewed is limited, which raises concerns about the review results' generalisability.

However, this evinces the need for developing more gamified experiences in this scope of training. On the other hand, research also indicates that an individual's experience with gamification may vary on the specific characteristics of users, situational relevance and possible contextual factors (Finckenhagen, 2015; Smiderle et al., 2020). There is no one-size-fits-all approach to gamifying learning. However, this study determines some implications of gamification and GBL as an active methodology, bringing together several experiences in a variety of fields.

6 Conclusion

The primary goal of this study was to obtain a better understanding of the phenomena of gamification and game-based learning in vocational education. While this new field of study is still in its infancy, it offers an exciting future. Gamification and game-based learning may be utilised as effective teaching and learning strategies to meet the requirements of 21st-century education. After the systematic literature review, it has been established that the use of gamification and game-based learning in the VET sector has been beneficial at different educational levels, from school or college to professional training. We discovered that, from 2020 forward, vocational institutions in Asia, particularly Thailand, have published the greatest number of studies on the topic. We also found that the engineering field produces the most articles on gamification and GBL in vocational education and training, followed by healthcare disciplines. From the discussion above, it is apparent that gamification and GBL technology include a wide variety of up-and-coming technologies, such as learning management systems (LMS) and massive open online courses (MOOC), immersive reality, serious game simulations, interactive media, and browser games. This means that the direction and pedagogy of the curricula, courses, and programmes must continue to adapt to meet the expanding needs of the digital economy. However, no precise objective has been set for how many vocational instructors have completely embraced the use of digital tools and technology in teaching, learning, and administrative work, as well as the related consequences. There is still a significant digital skills gap among vocational instructors, which impedes the pace of digital transformation in Malaysia, suggesting that all VET instructors must complete the technological pedagogy training programme to be competent in equipping students with the digital skills required by growth industries, well before the Covid-19 era.

The systematic study revealed various advantages of using gamified learning in vocational learners, including increased motivation, engagement, and academic accomplishment. Gamification and GBL might have a significant impact on the future of vocational education and training since they minimise the possibility of making mistakes. They may serve as a safe introduction to various dangerous occupational fields where failure is not an issue, in fact, it is anticipated while learning in a game. Although peer-reviewed research on gamification and game-based learning for vocational education found good benefits, journals in this field are scarce, and insights into the link between learners' educational game strategies and the outcomes of these learning strategies are still insufficient. However, this study

examined only conceptual and experimental academic studies conducted in selected databases (Web of Science, Scopus, PubMed, ScienceDirect, and a few from Google Scholar), excluding grey literature and book chapters. Future studies should take into consideration data sources from other databases or grey literature, such as conference papers and other publications.

Data availability The datasets supporting the conclusions of this article are included within the article.

Declarations

The authors have no relevant financial or non-financial interests to disclose.

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