INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN PROGRESSIVE EDUCATION & DEVELOPMENT

OPEN ACCESS JOURNAL

Vol 13, Issue 1, (2024) E-ISSN: 2226-6348

Educational Games and Game-based Approaches in Higher Education: A Systematic Review (2014-2023)

Gao Mingyu[1,2], Melor Md Yunus[1], Karmila Rafiqah M. Rafiq[3]

[1]Faculty of Education, Universiti Kebangsaan Malaysia, Bangi 43600, Malaysia, [2]Department of Computer Science and Technology, Xi'an Jiaotong University City College, Xi'an 710018, China, [3]Faculty of Education, Universiti Teknologi MARA, Puncak Alam Campus, 42300, Malaysia

Email: melor@ukm.edu.my, gaomy972@gmail.com, karmilarafiqah@gmail.com

Corresponding Author Email: P134219@siswa.ukm.edu.my

To Link this Article: http://dx.doi.org/10.6007/IJARPED/v13-i1/20555 DOI:10.6007/IJARPED/v13-i1/20555

Published Online: 24 January 2024

Abstract

With the leap of modern information technology, game-based methods, as a new teaching mode of higher education institutions, is booming. However, the review of educational games or gamification approaches in higher education is still insufficient though it has great informative significance in this area. By using the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analyses) method and two databases, namely Web of Science (WoS) and Scopus, a total of 31 articles were selected, from 2014 to 2023, with inclusion criteria. Two themes emerged from this review, namely the benefits and the challenges of gamification approaches used in higher education institutions. The findings show that game-based learning methods can positively inspire motivation improvement, engagement improvement, learning effectiveness, and knowledge gain of learners in higher learning. But in the meantime, the findings point out that only the cooperation of learners, educators, and institutions can meet the challenges and finally lead to effective learning outcomes.

Keywords: Educational Game, Game-Based Approach, Higher Education, Higher Learning, Tertiary Education

Introduction

In the field of education, educational games are of great significance. It can allow students to experience a virtual environment with real elements, and this is more engaging than simple online learning to create lifelong learning opportunities (Rafiq et al., 2021). With the leap of modern information technology and its application in the field of higher education, online educational games have attracted more and more attention all over the world. As one of the learning forms, game-based learning is a learning mode realized by using digital and video technologies. It breaks through the limitations of space and time and enables learners to have flexible learning plans according to their own conditions, promoting educational quality. It is the time for higher education to adjust the learning mode using games as a tool.

The problem in using a gamification approach in higher education is that the educators and students are used to traditional lectures, not used to learning the latest game-based learning technology in time. The most direct problem is that students do not have the ability to use this tool efficiently, and many of them still use games as simple entertainment after learning. Besides, educators also need the training because the development of educational games around the world has shown great advantages at the stage of higher education.

Although the development of research on educational games, past reviews are more about the online learning fields in higher education (Ramalingam et al., 2022), leaving a gap. However, it is crucial to investigate the research direction in educational games, specifically in higher education institutions. Thus, this study is to review the situation and research in educational games in higher education institutions, with two research questions:

RQ1: What are the benefits of educational games used in higher education institutions?
RQ2: What are the challenges of educational games used in higher education institutions?

Methodology

This part discusses how to use the method named PRISMA to select suitable studies related to educational games used in higher education institutions. It has steps, namely identification, screening, and included (Page et al., 2021), as shown in Figure 1.

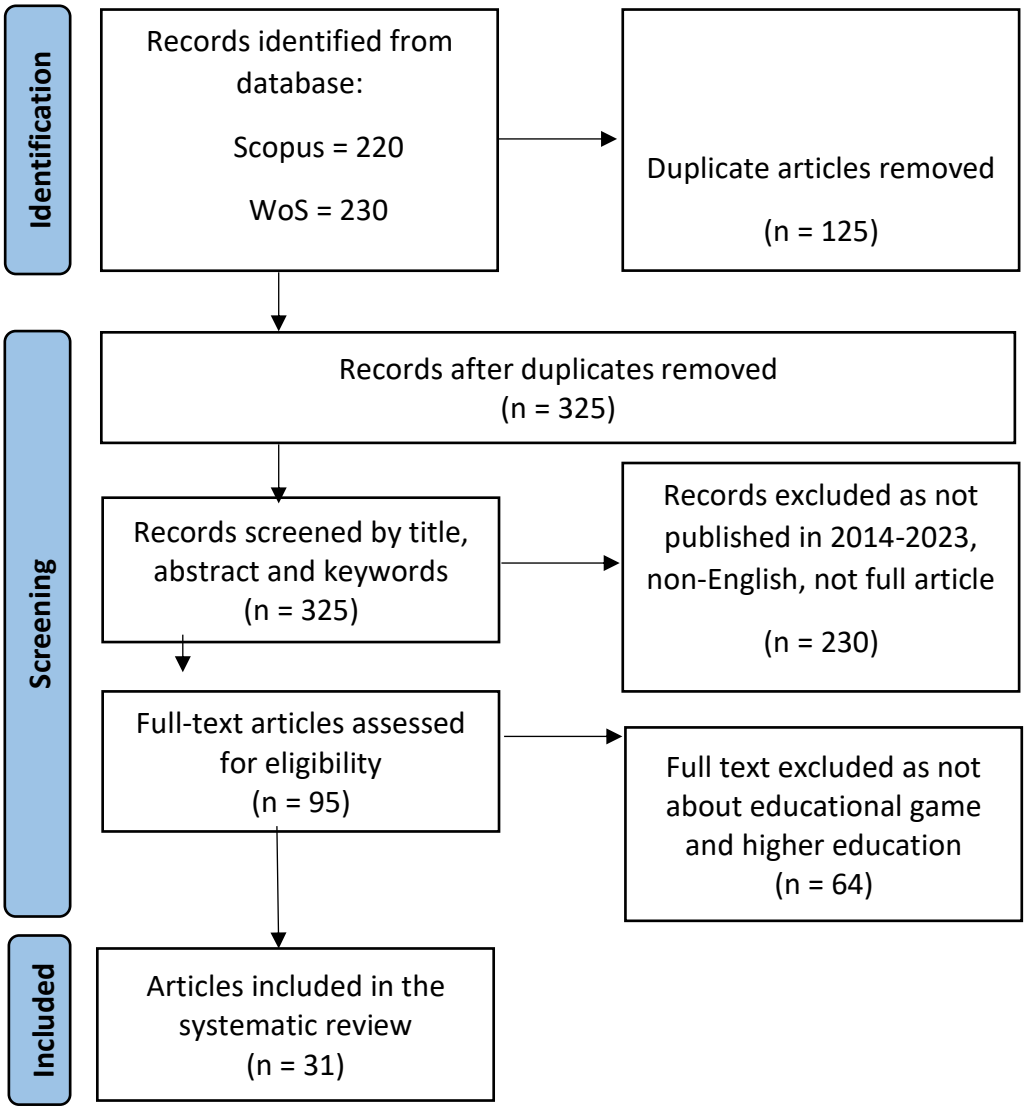

Figure 1. PRISMA systematic review flow chart.

Identification

The first step is identification. It finds and enriches the keywords of the research title, using Boolean operator or phrase searching or truncation to find similar or related terms, variations, and synonyms of the keywords for the study title, which are educational game and higher education in this study to find related studies which should be analyzed in this research. Then, the study can use the keywords and synonyms as search string to input to select articles in the two databases: WoS and Scopus, using different field codes. The search strings are shown in Table 1. A total of 450 articles were selected from the process.

Table 1
Search string for identification

Database	Search String
Scopus	TITLE-ABS-KEY ((“educational game *” OR “game-based approach *” OR “educational video game *” OR “gamify learning *”) AND (“higher education *” OR “higher learning *” OR “tertiary education *”))
WoS	TS = ((“educational game *” OR “game-based approach *” OR “educational video game *” OR “gamify learning *”) AND (“higher education *” OR “higher learning *” OR “tertiary education *”))

*: Search String.

Screening

The second step is screening. The 125 duplicate articles in two databases were deleted by the researcher. Then, using inclusion criteria to analyze the 325 eligible articles to do the screening based on title, abstract, and keywords, related to educational games and higher education. 230 articles were excluded, and 95 articles were screened by criteria in Table 2.

Table 2
Selection criteria of the articles

Inclusion Criteria	Exclusion Criteria
Articles published between 2014 and 2023	Articles published before 2014
Full articles from journals	Proceedings of conference, review articles, books, reports
Articles in English	Articles not in English
About educational game and higher education	Not about educational game and higher education

After thoroughly selecting based on Table 2, 64 articles that do not meet the selection criteria were excluded, remaining 31 articles to analyze.

Included

The studies which were included in this research are shown in Table 3.

Table 3
Summary of the selected articles.

Article	Database	Objective	Targets	Results
Mercer et al., 2017	WoS, Scopus	To discuss a novel life cycle method of education for sustainable development (ESD) to make students become “design thinkers”	57 students from a variety of subject backgrounds	Students experienced creativity of game developing in the process.
		To analyze students' views on the influence		Students' views on the influence of gamified

Boghian & Cojocariu, 2023	WoS	of gamified method on their social emotional skills	200 students from different learning programs	method on their social emotional learning skills, and suggestions on using games to build these skills.
Andrew Tong & Hee, 2023	WoS, Scopus	To design and evaluate the influence of a gamified method on health awareness	52 responses of self-administered questionnaire from female university students in Malaysia	Online games can be used as a health educational tool to improve the understanding of a certain topic like cancer.
Nardo & Gaydos, 2021	WoS, Scopus	To discuss the potential of digital games to create meaningful educational experiences which is helpful to moral learning	To design a new digital moral game, focusing on the difficulties	The biggest challenge when creating this educational moral game is to determine expected results.
Rosa-Castillo et al., 2023	WoS, Scopus	To check the influence of participating in an educational game based on Instagram on learning results	291 university students who were studying in the first year of the Bachelor of Nursing during, academic year 2020–2021	Students who were participating in the educational game based on Instagram had better learning results.
Ibrahim et al., 2018	WoS	To specify the factors that affect students' acceptance of educational games	180 undergraduate computer science students from UTM participated in the survey	Games designers can focus on learning expectancy, effort expectancy, attitude, and

				enjoyment concern with students in developing better games.
Pettit et al., 2015	WoS	To check students' acceptance of the gamified TurningPoint (TP) interactions	91 students in medical microbiology lectures responded to the survey at the end of their first year	Students pointed out the value of the engagement of gamified TP interactions.
Vodenicharova, 2022	WoS, Scopus	To specify the effectiveness of training in the management of logistic projects by using an educational game approach	4th year bachelor students, project managers	Game-based approaches in education can motivate students to gain better learning outcomes.
Ade-Ibijola et al., 2022	WoS	To teach students about plagiarism by a game called Plagi-Warfare	30 undergraduate and postgraduate students	Student got knowledge about plagiarism.
Checa et al., 2021	WoS	To design an educational game which makes students interact with concepts like computer hardware assembly to learn in a practical way	77 first-year students who were randomly arranged into 3 groups	The strong potential of VR serious games to foster students' well-being in isolation
Krishnan et al., 2023	WoS, Scopus	To check the realization of a virtual escape room game with hepatitis theme in pharmaceutical undergraduate program	418 students participated in a 60-minute online escape room game with hepatitis as the theme	Virtual escape room game is an effective teaching method to understand related concepts among students.
		Using Digital Educational	56 students from Rey Juan Carlos University	

Borrás-Gené et al., 2022	WoS, Scopus	Escape Room (DEER) to deal with the limitations of hybrid teaching	during the pandemic, who were divided between the classroom and their homes, academic year 2020-2021	The effectiveness of DEER and its application to different remote teaching situations.
Soboleva et al., 2023	WoS	To specify the potential role of gamification in forming a set of super-professional skills for future teachers, and explain the principles of using traditional and digital components to realize basic mechanics in teaching games with concrete examples	60 undergraduates from the training program "Psychological and Pedagogical Education" from Vyatka State University	The students of the experimental group are involved in different team work on educational games.
Kornevs et al., 2023	WoS, Scopus	To value the possibility of designing digital games by shaping professional tools themselves as games, creating a framework for this process	5 learning objectives for the students from a communication network course at the KTH Royal Institute of Technology, Sweden	The necessity to design games based on professional tools.
Jimoyiannis et al., 2022	WoS	To see the influence of a gamified intervention on students' acceptance of socio-political issues	92 undergraduate students from a Greek University, majoring in social science	The game changes certain elements of students' attitudes towards European identity.

Доброскок et al., 2020	WoS	To display the test results of free tools for making educational games, and to provide a list of features for evaluating and specifying the best games	32 teachers and 133 students from three universities from Ukraine, Turkey, and Bulgaria	Teachers and students were interested in making and using educational online games. It is very important to allow teachers to learn new information, try new activities and exchanges.
Aynsley et al., 2018	WoS, Scopus	To judge whether the students who played the game think that it is helpful to the study of pharmacology, and to evaluate the learning outcomes	125 Year 2 medical students from 3 sessions	Gamification has a good influence on students' confidence in learning knowledge and there are remarkable learning outcomes.
Toader et al., 2023	WoS	To compare the views of Polish and Romanian students on integrated educational games and improve their soft skills through games	103 students in the Project Management subject, from 2 different universities	Understanding the significance of some elements after games
		To define the relevance between game aspects as pedagogical approach,		Inspiring educators and developers involved in game based IVR and get in touch with the cognitive factors of learners

Agbo et al., 2023	WoS, Scopus	features of IVR technology, and learners' acceptance	49 undergraduate students who played iThinkSmart	whose purpose is to improve learning under the background of higher education and produce problem-solving skills in the 21st century through critical thinking.
Agbo et al., 2021	WoS	To support researchers and students' computational thinking skills in online collaborative design (OCD) of situational games, a method of designing online collaborative situational games with students is developed.	12 Computer science students from Nigeria	Participants gained relevant knowledge. Students are encouraged to create educational games in their future studies. The methods of obsessive-compulsive disorder with students.
Romero & Kalmpourtzis, 2020	WoS, Scopus	To explain the background of European higher education quality assurance challenges, reviews the suggestions on game design, and analyzes the game creating	Students at the University of the Cote d'Azur, contacting the teaching personnel of the course anytime	Curriculum structure, chances and limitations of game creating

		process in the game-based learning course of MSc SmartEdTech project through the prism of constructive alliance.		learning under the certain background of network education.
Hauge et al., 2021	WoS, Scopus	To check the defects of temporary game hosts' actual ability and their perceived ability	7 researchers defined the requirements for temporary game hosts	The ability required by the game host and the demand for specific formal training. The ability characteristic model of the game host, which is helpful to improve the efficiency of serious games.
Imam et al., 2022	WoS, Scopus	To see the possibility of game-based learning to teach finance	An undergraduate corporate finance subject taught at an Australian university, academic year 2020-2022	Game-based intervention may influence students' study in technical subjects, and it is necessary to seriously consider learners' requirements and abilities to obtain satisfactory results.
Vahldick et al., 2020	WoS, Scopus	To introduce the improvement of important games to assist in basic computer	A game named NoBug's SnackBar was used to undergraduate students in their first programming lecture	14 findings and suggestions on developing and using gamification methods to

		programming learning.		assist beginners' introductory learning of computer programming.
Padilla-Zea et al., 2022	WoS, Scopus	Combining teaching methods with technical methods will produce "Catch the open!" Shows the gamification of the interactive web-based APP and the APP itself.	153 educators from 6 higher education institutions , including 2 phases of piloting	The gamification environment is helpful for learning operation experience. On the other hand, learners also put forward some improvements in the gamification environment.
Zhyhadlo, 2022	WoS	Explaining several tool mechanisms based on digital games and analyzes their characteristics according to their effectiveness as a formative evaluation method for students and their ability to maximize the quality of teachers' feedback.	Interactive quizzes like Kahoot!, Wordwall or Mentimeter between teachers and students during foreign language lessons	Activities devised With the help of interactive quizzes in foreign language class, students can practice vocabulary and grammar with memory devices. It can also provide educators with various teaching tools and evaluation techniques to meet the needs of individual students.
		Verifying how the antecedents and		

Wan et al., 2021	WoS, Scopus	experiences of flow lead to the results of flow in the game-based learning environment.	275 students from undergraduate social science class	Learners attach great importance to game-based learning because of the premise of concentration and challenge.
Riabchun et al., 2019	Scopus	To find the influence of educational game for development of prospective students' spatial awareness	Prospective students and students of various specialties of Kiev National University of Building and Architecture	Providing opportunities for future students to use the distance graphics learning.
Frevert & Di Fuccia, 2021	Scopus	Showing students the current situation of modern chemistry, in which case they must play the role of forensic scientists.	Chemistry education students at the University of Kassel	Students are encouraged to try alternative methods of chemistry teaching, promoting students' digital ability, and showing them the potential of learning environment.
Hsbollah & Rosli, 2022	Scopus	To investigate the application of gamification learning method in making learning experience and its influence on encouraging students' subject knowledge.	120 students in a university who registered in the accounting system analysis and design course	Compared with the teacher-centered method, the game-based teaching method may assist students understand the classroom better. Respondents like to study in games, so

				learning courses are more attractive and fun.
Atmaja et al., 2020	Scopus	Filling the research gap by studying the incomprehensible educational platform game application in the higher education scene.	60 first-year students from the Informatics Engineering Department	This game can add elements of classroom fun in the context of unknown attributes. This method solves the problem of the development cost of educational games.

Analysis Procedure

Analyses were carried out to answer the two research questions:
RQ1: What are the benefits of educational games used in higher education institutions?
RQ2: What are the challenges of educational games used in higher education institutions?

Results from the selected studies are analyzed in the following part.

Results

RQ1: What are the benefits of educational games used in higher education institutions?

This systematic review points out that there are 13 main benefits of educational games used in higher educational institutions. These games can contribute to knowledge gain, enjoyment, educational development, behavioral change, educational tools, better learning outcomes, engagement improvement, motivation improvement, learning effectiveness, skill improvement, attitude change, self-management, and computational thinking. Table 4 displays the benefits of gamification methods in higher education according to past studies.

Table 4
Benefits of educational game used in higher education.

Benefit	Examples
Knowledge gain	[Aynsley et al., 2018] [Agbo et al., 2021] [Checa et al., 2021] [Ade-Ibijola et al., 2022] [Hsbollah & Rosli, 2022] [Hsbollah & Rosli, 2022] [Krishnan et al., 2023]
Enjoyment	[Aynsley et al., 2018] [Atmaja et al., 2020)] [Ade-Ibijola et al., 2022] [Krishnan et al., 2023]

Educational development	[Mercer et al., 2017] [Romero & Kalmpourtzis, 2020]
Behavioral change	[Mercer et al., 2017][Ibrahim et al., 2018]
Educational tool	[Pettit et al., 2015] [Mercer et al., 2017] [Padilla-Zea et al., 2022] [Andrew Tong & Hee, 2023]
Better learning outcomes	[Nardo & Gaydos, 2021] [Rosa-Castillo et al., 2023]
Engagement improvement	[Pettit et al., 2015] [Pettit et al., 2015] [Hsbollah & Rosli, 2022] [Andrew Tong & Hee, 2023]
Motivation improvement	[Pettit et al., 2015] [Доброскок et al., 2020] [Frevert & Di Fuccia, 2021] [Agbo et al., 2021] [Wan et al., 2021] [Vodenicharova, 2022][Ade-Ibijola et al., 2022] [Zhyhadlo, 2022] [Andrew Tong & Hee, 2023]
Learning effectiveness	[Aynsley et al., 2018] [Riabchun et al., 2019] [Vahldick et al., 2020] [Checa et al., 2021][Borrás-Gené et al., 2022]
Skill improvement	[Zhyhadlo, 2022] [Vodenicharova, 2022] [Boghian & Cojocariu, 2023] [Krishnan et al., 2023] [Soboleva et al., 2023]
Attitude change	[Aynsley et al., 2018] [Checa et al., 2021] [Jimoyiannis et al., 2022]
Self-management	[Hsbollah & Rosli, 2022] [Boghian & Cojocariu, 2023] [Toader et al., 2023]
Computational thinking	[Vahldick et al., 2020] [Agbo et al., 2023]

As shown in Table 4, 7 articles show that game-based approach contributes to measurable knowledge gain for higher education learners. Students can learn a lot about the subject they discussed in the course and improve slightly by raising awareness of it. It can decline learning anxiety as well (John & Yunus, 2021).

What's more, 4 articles show students can acquire enjoyment from educational games. This approach is a way to link academic contents and fun of games, catch more learners' interest by its stress-free environment (Rajendran & Yunus, 2021)and make them accept learning contents smoothly with a positive attitude.

Another benefit of game-based method in this systematic review is that it can lead to educational development, based on 2 past studies. It provides opportunities for educators and institutions to make decisions with the aim through data analysis. It cannot be denied that game-based approaches encourage a better beneficial learning and teaching environment to get skills (Santhanasamy & Yunus, 2022).

Furthermore, another 2 studies show that gamified learning may cause positive behavioral changes for students. Using it may influence students' behavioral intentions, making students

"thinkers" but not only "listeners". For example, they may enjoy their creativity when they participate in a game design exercise.

As mentioned in 4 articles, a game-based approach can be used as an important educational tool. Since it is a resource which can be accessed and updated more easily than the traditional curriculum, being proved to be a useful classroom tool. It can be a two-way tool, not only boosting the knowledge absorption in game but also inspire students extract and apply them in game by doing task or something else.

Besides, 2 studies display that gamify learning encourages better learning outcomes. According to past studies, students who participated in experimental groups showed better learning outcomes like final course grades rather than the people who did not.

Also, 4 studies depict that game-based approach enhances engagement improvement of learners. According to past studies, students showed high perceptions about educational games and valued the engagement of gamified interactions.

Next, 9 articles show that game-based learning inspires the motivation improvement of learners. Gamification can be entertaining ways to catch students' attention. For example, gamification can motivate learners to attempt by friendly competition like individual competition and team competition by moving students' emotions like ambitions and efforts, giving them satisfaction by game performance.

5 articles studies display that game-based approach influences learning effectiveness of learners, making them understand faster and make fewer errors, easier to monitor themselves, interact with course mates, focus on learning contents, and provide feedback to get immersion experience and better retention.

Moreover, 5 studies display that game-based learning plays a role in skill improvement of learners. According to past studies, educational games can build socio-emotional skills like reflective thinking, critical thinking, organizational skills, communication, and collaboration.

3 studies depict that display game-based approach that make attitude change of students. As shown in a past study, playing the game changes learners' attitudes and feels more connection about country and nationality.

Next, 3 articles depict that gamify learning creates self-management of learners. It may fully maximize the learning capability of students, which contributes to promoting students' communication skills, problem-solving skills, stress management, time management, and eventually lead to self-study.

Finally, 2 articles show that game-based learning generates computational thinking. Gamification fosters students' comprehension in handling contents logically.

RQ2: What are the challenges of educational games used in higher education institutions?
This systematic review points out that there are 6 main challenges of educational games used in higher educational institutions. These games may encounter challenges like lead-in,

expected outcomes, usability, game design, teacher training, and constructive alignment. Table 5 displays the challenges of gamification methods in higher education according to past studies.

Table 5
Challenges of educational game used in higher education.

Challenge	**Study**
Lead-in	[Mercer et al., 2017] [Checa et al., 2021]
Expected outcomes	[Ibrahim et al., 2018] [Nardo & Gaydos, 2021]
Usability	[Checa et al., 2021] [Ade-Ibijola et al., 2022] [Imam et al., 2022]
Game design	[Imam et al., 2022] [Soboleva et al., 2023]
Teacher training	[Доброскок et al., 2020][Hauge et al., 2021] [Kornevs et al., 2023]
Constructive alignment	[Mercer et al., 2017] [Romero & Kalmpourtzis, 2020]

As shown in Table 4, 2 articles show that learners may need lead-in in gamify learning. Students who use games as an educational tool for the first time may not complete self-guide, they need supervisor or coach in course to support them or give them tutorials both in technology and psychology and adapt to the new learning tool.

What's more, 2 articles show that students may have some difficulties in creating expected outcomes in educational learning. Since educators and institutions had prepared the subject and information which they want to introduce beforehand like encoding, it is a tollgate for students to do the decoding to get the key points they need to master in different courses.

Another challenge of game-based approaches in this systematic review is usability, based on 3 studies. Issues like ease, local solution, gaming environment and new problems emerge in the game progress may lead to some challenges for game developers.

Furthermore, 2 studies display that game-based learning methods rely on game design. There are some issues that must be discussed in the process of game design, like rules and potential of players, length, purposes, function, limitation, and impact of games.

As mentioned in 3 articles, gamified learning may need teacher training. Making an educational game may use some professional engineering tools and teachers need to comprehend the principle of the game to teach students effectively. Besides, teachers also need to be required to join specific training master some latest digital skills with models in time and get more experience in the gamification field to observe students' performance and feedback.

Besides, 2 articles show that educational learning inspires constructive alignment. For example, according to the study which has used educational games as an educational tool to improve students' behaviors, the practice must be aligned to achieve its goals by assessment of learners and educators. Students need time to reflect and evaluate their game

performance and educators and institutions can use their feedback to align the course or construction to reduce cognitive load.

Discussion

The result of this review points out the benefits and challenges of educational games used in higher education institutions.

Firstly, the findings highlight that game-based learning expands the utility of digital games, inspiring motivation improvement and knowledge gain of learners in higher learning. Because of the enjoyment of games, it can be used as a tool to encourage positive behavioral and attitude change, engagement improvement, motivation improvement, skill improvement, cultivating computational thinking and finally leading to self-management and better learning outcomes effectively. Besides, it can not only inspire learners' improvement, but also contribute to educational development. In conclusion, game-based approaches can create a learner-centered learning mode for students to manage and improve themselves.

Also, this review points out that there are some issues to pay a high level of attention to. For learners, they may need some support and guidance from educators and institutions to lead-in and get directions to acquire expected outcomes when they start their gamify learning. For educators, they need to improve the usability, constructive alignment, and game design of educational games. For education institutions, they may need to hold some teacher training to ensure the effectiveness of game-based approaches. In summary, it is not an easy shift for higher education from traditional methods to learner-centered ones.

Conclusions

In summary, this study has analyzed studies about educational games in higher education institutions. The paper is to analyze the latest utilization of gamification learning approaches for higher education lectures. Databases, namely WoS and Scopus, have been used and 31 articles were selected according to the PRISMA method. The main results emphasize the benefits and challenges of gamified learning approaches in higher education.

The findings show that gamification learning approaches can bring positive behavioral and attitude change to learners and inspire motivation improvement, skill improvement, engagement improvement, and knowledge gain of them in higher learning context, and eventually lead to better learning outcomes. Besides, it can not only encourage learners' improvement, but also contribute to educational development.

But in the meantime, the findings point out that only the cooperation and efforts of learners, educators, and institutions can solve the issues in gamification learning process and lead to effective game-based learning.

Based on the results, educators and learners can find suitable game-based learning tools to utilize in teaching and learning activities in their higher education context. Moreover, educators should pay attention to the challenges of gamification approaches to utilize and improve educational games as a support of education activities.

This research has a few limitations. Firstly, it focuses on higher education but not a specific course. Future studies could try to focus on a particular subject to examine suitable games used to improve higher education learning outcomes. Secondly, this review was organized with articles from two databases, namely WoS and Scopus. Thus, the results might be different from now if the author uses other databases such as Science Direct, Google Scholar, and so on.

Despite its limitations, this research provides some outcomes about game-based learning approaches. It also enables people to get knowledge of recent game-based learning trends. Moreover, it points out important topics that should be researched in the future. Future researchers could pay attention to learners' emotions and the materials which can be used in educational games in higher education.

Author contributions: All authors have sufficiently contributed to the study and agreed with the results and conclusions.

Funding: No funding source is reported for this study.

Declaration of interest: No conflict of interest is declared by authors.

References

Ade-Ibijola, A., Young, K., Sivparsad, N., Seforo, M., Ally, S., Olowolafe, A., & Frahm-Arp, M. (2022). Teaching Students About Plagiarism Using a Serious Game (Plagi-Warfare): Design and Evaluation Study. *JMIR Serious Games*, *10*(1). https://doi.org/10.2196/33459

Agbo, F. J., Olaleye, S. A., Bower, M., & Oyelere, S. S. (2023). Examining the relationships between students' perceptions of technology, pedagogy, and cognition: the case of immersive virtual reality mini games to foster computational thinking in higher education. *Smart Learning Environments*, *10*(1). https://doi.org/10.1186/s40561-023-00233-1

Agbo, F. J., Oyelere, S. S., Suhonen, J., & Laine, T. H. (2021). Co-design of mini games for learning computational thinking in an online environment. *Education and Information Technologies*, *26*(5), 5815–5849. https://doi.org/10.1007/s10639-021-10515-1

Andrew Tong, J. W., & Hee, M. Q. (2023). The impact of an online educational game on breast cancer awareness among university female students, Malaysia: a pilot study. *BMC Cancer*, *23*(1). https://doi.org/10.1186/s12885-023-11427-8

Atmaja, P. W., Muttaqin, F., & Sugiarto, S. (2020). Facilitating educational contents of different subjects with context-agnostic educational game: A pilot case study. *Register: Jurnal Ilmiah Teknologi Sistem Informasi*, *6*(1), 52–64. https://doi.org/10.26594/register.v6i1.1726

Aynsley, S. A., Nathawat, K., & Crawford, R. M. (2018). Evaluating student perceptions of using a game-based approach to aid learning: Braincept. *Higher Education Pedagogies*, *3*(1), 70–81. https://doi.org/10.1080/23752696.2018.1435296

Boghian, I., & Cojocariu, V.-M. (2023). Using Games to Build Social Emotional Learning Skills. *Revista Romaneasca Pentru Educatie Multidimensionala*, *15*(1), 622–656. https://doi.org/10.18662/rrem/15.1/715

Borrás-Gené, O., Díez, R. M., & Macías-Guillén, A. (2022). Digital Educational Escape Room Analysis Using Learning Styles. *Information (Switzerland)*, *13*(11). https://doi.org/10.3390/info13110522

Checa, D., Miguel-Alonso, I., & Bustillo, A. (2021). Immersive virtual-reality computer-assembly serious game to enhance autonomous learning. *Virtual Reality*. https://doi.org/10.1007/s10055-021-00607-1

Frevert, M., & Di Fuccia, D. S. (2021). Possibilities of Learning Contemporary Chemistry via Virtual Reality. *World Journal of Chemical Education*, *9*(1), 1–7. https://doi.org/10.12691/wjce-9-1-1

Hauge, J. B., Söbke, H., Bröker, T., Lim, T., Luccini, A. M., Kornevs, M., & Meijer, S. (2021). Current competencies of game facilitators and their potential optimization in higher education: Multimethod study. *JMIR Serious Games*, *9*(2). https://doi.org/10.2196/25481

Hsbollah, H. M., & Rosli, K. (2022). Creating Meaningful Learning and Improving Students‟ Knowledge Using Game-based Learning in Higher Education. *World Journal of English Language*, *12*(2), 257–266. https://doi.org/10.5430/wjel.v12n2p257

Ibrahim, R., Masrom, S., Yusoff, R. C. M., Zainuddin, N. M. M., & Rizman, Z. I. (2018). Student acceptance of educational games in higher education. *Journal of Fundamental and Applied Sciences*, *9*(3S), 809. https://doi.org/10.4314/jfas.v9i3s.62

Imam, T., Cowling, M., & Das, N. (2022). Designing Computer Games to Teach Finance and Technical Concepts in an Online Learning Context: Potential and Effectiveness. *Mathematics*, *10*(22). https://doi.org/10.3390/math10224205

Jimoyiannis, A., Boyle, E. A., Tsiotakis, P., Terras, M. M., & Leith, M. S. (2022). Exploring the Impact of the "RUEU?" Game on Greek Students' Perceptions of and Attitudes to European Identity. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.834846

John, E., & Yunus, M. M. (2021). A systematic review of social media integration to teach speaking. In *Sustainability (Switzerland)* (Vol. 13, Issue 16). MDPI. https://doi.org/10.3390/su13169047

Kornevs, M., Krishna, H., & Orhan, I. (2023). Framework for Using Professional Engineering Tools to Develop Games in Post-Secondary Education. *International Journal of Serious Games*, *10*(1), 39–52. https://doi.org/10.17083/ijsg.v10i1.542

Krishnan, S., Blebil, A. Q., Dujaili, J. A., Chuang, S., & Lim, A. (2023). Implementation of a hepatitis-themed virtual escape room in pharmacy education: A pilot study. *Education and Information Technologies*. https://doi.org/10.1007/s10639-023-11745-1

Mercer, T. G., Kythreotis, A. P., Robinson, Z. P., Stolte, T., George, S. M., & Haywood, S. K. (2017). The use of educational game design and play in higher education to influence sustainable behaviour. *International Journal of Sustainability in Higher Education*, *18*(3), 359–384. https://doi.org/10.1108/IJSHE-03-2015-0064

Nardo, A., & Gaydos, M. (2021). 'Wicked problems' as catalysts for learning in educational ethics games. *Ethics and Education*, *16*(4), 492–509. https://doi.org/10.1080/17449642.2021.1979283

Padilla-Zea, N., Burgos, D., García-Holgado, A., García-Peñalvo, F. J., Harquevaux, M. P., de-la-Higuera, C., Brunton, J., & Tlili, A. (2022). Catch the Open! A Gamified Interactive Immersion Into Open Educational Practices for Higher Education Educators. *Frontiers in Psychology*, *13*. https://doi.org/10.3389/fpsyg.2022.812091

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. In *The BMJ* (Vol. 372). BMJ Publishing Group. https://doi.org/10.1136/bmj.n71

Pettit, R. K., McCoy, L., Kinney, M., & Schwartz, F. N. (2015). Student perceptions of gamified audience response system interactions in large group lectures and via lecture capture technology Approaches to teaching and learning. *BMC Medical Education*, *15*(1). https://doi.org/10.1186/s12909-015-0373-7

Rafiq, K. R. M., Hashim, H., & Yunus, M. M. (2021). Sustaining education with mobile learning for english for specific purposes (Esp): A systematic review (2012–2021). In *Sustainability (Switzerland)* (Vol. 13, Issue 17). MDPI. https://doi.org/10.3390/su13179768

Rajendran, T., & Md Yunus, M. (2021). A Systematic Literature Review on the use of Mobile-assisted Language Learning (MALL) for Enhancing Speaking Skills among ESL and EFL Learners. *International Journal of Academic Research in Progressive Education and Development*, *10*(1). https://doi.org/10.6007/ijarped/v10-i1/8939

Ramalingam, S., Yunus, M. M., & Hashim, H. (2022). Blended Learning Strategies for Sustainable English as a Second Language Education: A Systematic Review. In *Sustainability (Switzerland)* (Vol. 14, Issue 13). MDPI. https://doi.org/10.3390/su14138051

Riabchun, Y., Honcharenko, T., Honta, V., Chupryna, K., & Fedusenko, O. (2019). Methods and means of evaluation and development for prospective students' spatial awareness. *International Journal of Innovative Technology and Exploring Engineering*, *8*(11), 4050–4058. https://doi.org/10.35940/ijitee.K1532.0981119

Romero, M., & Kalmpourtzis, G. (2020). Constructive alignment in game design for learning activities in higher education. *Information (Switzerland)*, *11*(3). https://doi.org/10.3390/info11030126

Rosa-Castillo, A., García-Pañella, O., Roselló-Novella, A., Maestre-Gonzalez, E., Pulpón-Segura, A., Icart-Isern, T., & Solà-Pola, M. (2023). The effectiveness of an Instagram-based educational game in a Bachelor of Nursing course: An experimental study. *Nurse Education in Practice*, *70*. https://doi.org/10.1016/j.nepr.2023.103656

Santhanasamy, C., & Yunus, M. M. (2022). A systematic review of flipped learning approach in improving speaking skills. In *European Journal of Educational Research* (Vol. 11, Issue 1, pp. 127–139). Eurasian Society of Educational Research. https://doi.org/10.12973/eu-jer.11.1.127

Soboleva, E. V., Suvorova, T. N., Chuprakov, D. V., & Khlobystova, I. Y. (2023). Formation of "Teamwork Skills" in Future Teachers when Creating Didactic Games with Traditional and Digital Components. *European Journal of Contemporary Education*, *12*(1), 188–203. https://doi.org/10.13187/ejced.2023.1.188

Toader, C. S., Brad, I., Rujescu, C. I., Dumitrescu, C. S., Sîrbulescu, E. C., Orboi, M. D., Pașcalău, R., Zajdel, M., Michalcewicz-Kaniowska, M., & Gavrilă, C. (2023). Exploring Students' Opinion towards Integration of Learning Games in Higher Education Subjects and Improved Soft Skills—A Comparative Study in Poland and Romania. *Sustainability (Switzerland)*, *15*(10). https://doi.org/10.3390/su15107969

Vahldick, A., Farah, P. R., Marcelino, M. J., & Mendes, A. J. (2020). A blocks-based serious game to support introductory computer programming in undergraduate education. *Computers in Human Behavior Reports*, *2*. https://doi.org/10.1016/j.chbr.2020.100037

Vodenicharova, M. (2022). Gamed-based Learning in Higher Education. *TEM Journal*, *11*(2), 779–790. https://doi.org/10.18421/TEM112-35

Wan, K., King, V., & Chan, K. (2021). Examining Flow Antecedents in Game-Based Learning to promote Self-Regulated Learning and Acceptance. *The Electronic Journal of E-Learning*, *19*(6), 531–547. www.ejel.org

Zhyhadlo, O. Y. (2022). APPLICATION OF DIGITAL GAME-BASED TOOLS FOR FORMATIVE ASSESSMENT AT FOREIGN LANGUAGE LESSONS. *Information Technologies and Learning Tools*, *87*(1), 139–150. https://doi.org/10.33407/itlt.v87i1.4703

Доброскок, І., Ржевська, Н., Айїлдиз, Х., Заімова, Д., & Желязков, Г. (2020). GAME DEVELOPMENT SOFTWARE TOOLS IN HIGHER EDUCATIONAL INSTITUTIONS: EXPERIENCE OF UKRAINE, TURKEY AND BULGARIA. *Information Technologies and Learning Tools*, *78*(4), 90–104. https://doi.org/10.33407/itlt.v78i4.3370