INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN PROGRESSIVE EDUCATION & DEVELOPMENT

OPEN ACCESS JOURNAL

Vol 11, Issue 4, (2022) E-ISSN: 2226-6348

A Narrative Review of Digital Educational Games in Learning for Undergraduate Students

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To Link this Article: http://dx.doi.org/10.6007/IJARPED/v11-i4/16084 DOI:10.6007/IJARPED/v11-i4/16084

Published Online: 27 December 2022

Abstract

Digital games are nothing new to today's youth. The education system is no exception, as it also employs digital education games (DEG) in the teaching and learning process. The purpose of this narrative review is to demonstrate the impact of DEG on learning for undergraduate students, to explain the role of DEG for undergraduate students and to describe strategies for minimizing obstacles associated with DEG implementation. The narrative review procedure involves selecting journals related to educational digital games. Three keywords have been used to search the relevant articles: “digital educational games”, “learning” and “undergraduate students”. The result shows that DEG contributes to critical factors influencing students' learning attitudes and educational intentions. It also aids in the formation of environmentally conscious attitudes and behaviors in students. DEG has the advantage of being active, practical and problem-based, as well as providing immediate feedback.

Keywords: Narrative Review, Educational Digital Game, Learning, Undergraduate Student.

Introduction

Educational games are those that are intentionally designed for the purpose of education, as opposed to entertainment games that have incidental or educational values. Educational games are intended to help people understand concepts, learn domain knowledge and develop problem-solving skills while they play (Zheng, 2016). Freitas's study (as cited in Manesis, 2020) defined those Digital Educational Games (DEG) are software applications which combine both the characteristics of video games and those of computer-based games. They aim to design enticing learning experiences that successfully correspond to specific learning aims and results. Over the past decade, many researchers and educators have integrated mobile technology and the features of gaming into their instructional designs (Chang & Hwang, 2019). However, the studies mentioned above also have their limitations. They did not comprehensively analyze implementation DEG among undergraduate student, but only analyzed a particular respondent, such as school and kindergarten students. This narrative review is to demonstrate the impact of DEG on learning for undergraduate students,

to explain the role of DEG for undergraduate students and to describe strategies for minimizing obstacles associated with DEG implementation.

Methodology

This paper uses the method of narrative review, which is commonly used to describe general literature reviews based on various research results. Guidance on the Conduct of Narrative Synthesis in Systematic Reviews as cited by Manesis (2020) define that a narrative review is a description of the variously related research results.

Narrative Review Procedure

This narrative review goes through several stages. The review looks for and selected relevant studies on the topic. The decision to choose the article was made after an outline review of the study's findings. Even though the database has a large number of publications, not all of the study's findings are relevant to the DEG research topics. In addition, the authors sort and classify the publications to address the following three research questions:
RQ1: What impact does DEG have on undergraduate students?
RQ2: What role does DEG play for undergraduate students?
RQ3: What is the strategy for overcoming the challenges associated with DEG implementation?

Primary Studies Selection

The primary investigations were conducted using the following e-journal databases: ScienceDirect, SpringerLink, Sage Journal Online, Taylor & Francis, IEEE and Scopus. “Digital educational games”, “learning” and “undergraduate students” are the three keywords that were employed in this study to investigate the research question.

Four inclusion criteria were used in this investigation:
1. Studies published between 2012 and 2022.
2. Studies that focused on digital educational games settings.
3. Studies that focused on learning settings.
4. Studies that focused on undergraduate settings.

Three exclusion criteria were used in this investigation:
1. Studies that were not published in English.
2. Studies that had insufficient data to calculate effect sizes.
3. Studies for which the full text was unavailable.

The data collection process is depicted in Figure 1, which includes searching, screening and choosing qualified articles for inclusion.

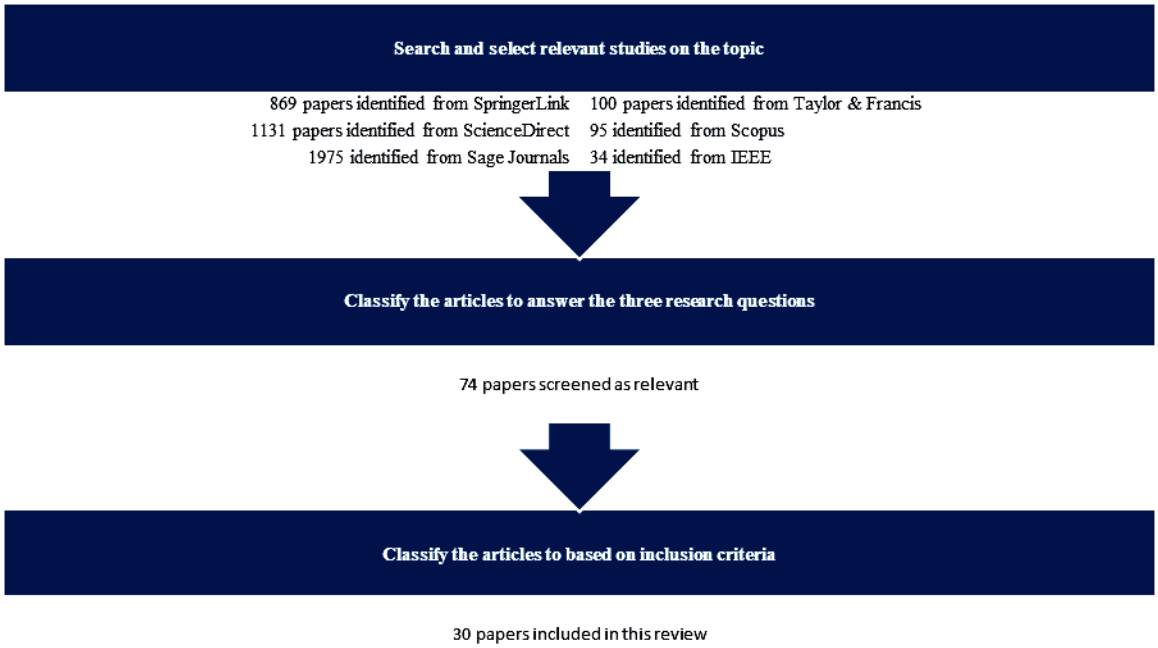

Figure 1. Flow chart of the narrative review selection process for the present article

By using the keywords "digital educational games", "learning" and "undergraduate students", 869 papers were identified from SpringerLink, 1131 papers from ScienceDirect, 1975 papers from Sage Journals, 100 papers from Taylor & Francis, 95 papers from Scopus and 34 papers from IEEE. 74 papers were determined to be relevant to the research questions RQ1, RQ2, and RQ3. 30 papers were chosen for this review because they met the inclusion criteria.

Result

A total of 30 primary studies on DEG had been identified. They met the criteria for inclusion in this review and suitable to answer the research questions.

Table 1

Articles Included in The Narrative Review

criteria	Author and year of publication	Study sample	Finding
Impact	De Troyer et al (2019)	1st year undergraduate students of Computer Science, University of Brussel.	Under the guidance of a teaching assistant, the game has a similar educational impact to a conventional training session.
	Wu et al (2022)	84 undergraduate students.	There are critical factors that influence students' learning attitudes and intentions regarding STEAM education.
	Garnett & Button (2018)	1st year undergraduate students of nursing, Australian University	With the aid of digital education, students have the possibility to improve their learning more independently before entering classes.
	Hoyng (2022)	336 students participating in a team-based business simulation game at two universities in Germany.	Engagement in groups develops students' good relationships.
	Barr (2018)	20 undergraduate students.	Playing games helps students interact and build their skills, which is important for learning.
	Janakiraman et al (2021)	A group of undergraduate students in an educational technology course.	Digital gaming encourages environmentally conscious attitudes and actions. Playing digital games can also

			improve learning in the areas of cognitive, emotional, behavioural and social learning.
	Türkistanli & Kuleyin (2022)	30 undergraduate maritime transportation engineering students	Through the use of game-based decision-making training, students gain a deeper understanding of a course.
	Rondon et al (2013)	29 of 2nd year students of Speech Language and Hearing Science students, School of Medicine, University of São Paulo.	The game-based learning method is equivalent to the traditional learning approaches in general and in short-term achievements. The traditional lectures are more effective at increasing the retention of students' short- and long-term knowledge.
	Campillo-Ferrer et al (2020)	101 of 2nd year students of the Primary Education, University of Murcia, Spain	Students have the chance to collaborate in group activities while respecting one another and embracing opposing viewpoints due to the cooperative action components of digital games.
	Pakinee & Puritat (2021)	Students of Financial Tracking in Digital Business, College of Art & Media Technology, Chiang Mai University.	Each component of the game affects various personality types differently, both positively and negatively. Gamification therefore cannot enhance the general knowledge for all personality types.
Role	Wronowski et al (2020)	218 of 4th year undergraduate students from research incentive institution.	Serious Educational Games may be a useful replacement for conventional methods of learning outside of the classroom for students who may not learn best that way.
	Go et al (2022)	Undergraduate students in information technology, hospitality management, industrial engineering and education in a state university, Philippines.	The incorporation of digital games may help students' abilities in fundamental mathematics.
	Sufiana & Goh (2022)	Undergraduate students majoring in Project & Facilities Management.	The design elements of the game have an impact on how well learning objectives are met.
	Hara et al (2021)	30 students from two undergraduate nursing courses.	The serious game offers cutting-edge multimedia tools for improving communication skills, like creating a welcoming and secure environment.
	Hamlen (2017)	191 undergraduate students in an American college and university.	Good achievement in learning can be gained through playing educational digital games which use the strategies of continuous practicing, problem-solving and thinking through the best possible option, using trial and error, trying the difficult parts continuously and a preference for playing a challenging digital game.
	Chan et al (2017)_	76 undergraduate students in law of torts classes Singapore Management University.	The development of other games that similarly attempt to build socially engaged and constructivist learning settings can benefit from the qualitative findings of games that helped students understand course material while having fun.
	Yadav & Oyelere (2021)	42 of 3rd year undergraduate students of Tribhuvan University, Institute of Engineering, Kathmandu, Nepal.	An interactive learning environment is a component of blended learning, which combines learning with games.
	Klit et al (2018)	189 students of Danish Agriculture Colleges.	Students are more engaged, problem-based, experiential and receive immediate feedback when learning through games.
	Sipiyaruk et al (2017)	158 of undergraduate students of King's College London	Gaming activity is a feature of serious games that is useful. Academicians can use it to recognize and support students' learning achievements.
	Murillo-Zamorano et al (2021)	132 students of the Faculty of Business and Economics, University of Extremadura, Spain.	Gamification encourages the development of abilities needed in today's job when used in the context of active learning. Gamification is another example of an instructional tool that might appeal to online communities' interests.
Strategy	Zafar et al (2014)	44 students of community college.	Computer games should be created in the native language in order to enhance the academic performance and motivation of students in countries where English is not the primary language.

	Lytridis & Tsinakos (2018)	205 students.	Videos, particularly 3D models, are used in the course material to help students understand concepts.
	Calabor et al (2019)	Undergraduate students of accounting education.	Universities and policymakers should offer more incentives to encourage academics to use new teaching technologies.
	Ng et al (2021)	328 pharmacy students in Malaysia.	Mobile games that offer rewards are more popular among students to play. Role-playing games, planning techniques and cooperative game types are among the available game genres.
	Toh & Kirschner (2020)	11 participants ages ranged from 19 to 24.	It is possible to adapt video game self-directed learning techniques for usage in pedagogical settings.
	Kaimara et al (2022)	263 undergraduate students from Departments of Education in Greece.	It was a good idea to employ DEGs for collaborative learning.
	Osorio & Ospina (2021)	Undergraduate student of the Metropolitan Technological Institute, Medellín, Colombia.	Three important factors were taken into consideration when designing the game: "according to numerous investigations", "contribute to the development of students' cognitive skills" and "game mechanics, narrative and aesthetics."
	Kayyali et al (2021)	Undergraduate pharmacy and nursing courses, Kingston University	Serious games should be incorporated into the curriculum, according to participants.
	Mellor et al (2018)	Seventeen of chemistry educators, government scientists, and chemical industry leaders.	Students should be able to connect games to real-world situations and scientific concepts.
	Dowling-Hetherington et al (2017)	275 undergraduate students, College of Business, University College Dublin	The use of digital technology in conjunction with modules is advantageous because it can aid students in planning their coursework, keeping track of their progress and motivating them to interact with the module material throughout the semester.

To answer the research questions, Table 1 was divided into three criteria: "impact", "role" and "strategy" involving DEG implementation.

RQ1

According to the findings in Table 1, DEG implementation is one of the crucial variables that affects students' learning attitudes and educational intentions (Wu et al., 2022). DEG has the potential to encourage students to enhance their learning by being well-prepared before entering the classroom (Garnett & Button, 2018). Additionally, DEG helps students build environmentally conscientious attitudes and practises. The game enhanced their learning in the cognitive, affective, behavioural and social domains (Janakiraman et al., 2021). It also offers a variety of cooperative activities where students can participate in group projects while honouring one another and recognising opposing viewpoints (Campillo-Ferrer et al., 2020). However, DEG cannot increase general knowledge for all personality types because each game element has both positive as well as negative effects on each learner (Pakinee & Puritat, 2021).

The application of DEG has the same educational impact as a conventional exercise session guided by a teaching assistant (De Troyer et al., 2019). Furthermore, the relationship between teaching support and student experience is positively influenced by group participation (Hoyng, 2022). The DEG technique is equivalent to conventional ways of learning in terms of overall and immediate gains, although conventional lectures seem to be more successful in enhancing students' short-term and long-term knowledge (Rondon et al., 2013). Even though DEG was crucial for the development of skills, it was also crucial for the students to interact with one another through game play (Barr, 2018). Additionally, the decision-

making training element in DEG helped students understand the subject more clearly (Türkistanli & Kuleyin, 2022).

RQ2

When discussing DEG's role, it provides an interactive learning environment that combines gaming and learning (Yadav & Oyelere, 2020). DEG assisted students in consolidating their course material while having fun. These discoveries can guide the development of DEG in order to promote interactive learning atmospheres (Chan et al., 2017). Serious DEG may be an effective replacement for conventional study time to increase their affect toward the particular subject (Wronowski et al., 2020). It is because DEG has the benefit of being dynamic, practical and problem-based, as well as providing immediate feedback (Klit et al., 2018). Furthermore, it employs repetitive practise, problem-solving and deciding over the best approach, using trial and error and repeat the challenging sections to allow for better learning (Hamlen, 2017).

DEG provides a safe and enjoyable atmosphere for the competency of communication skills due to the innovative use of multimedia resources (Hara et al., 2021). As an example, interaction while playing a game is a key design element that influences whether learning objectives are met (Sufiana & Goh, 2022). Gaming activities can be considered a beneficial feature that allows academic staff to identify and assist students in achieving their learning outcomes (Sipiyaruk et al., 2017). Furthermore, the use of DEG can help students improve their skills in fundamental subjects like mathematics (Go et al., 2022). In the context of active learning, gamification promotes the progress of skills required by the current workplace and an educational tool that can cater to the needs of the digital culture (Murillo-Zamorano et al., 2021).

RQ3

We listed several strategies that can be used to overcome the challenges associated with DEG implementation. Videos, particularly 3D models, have the greatest impact on conceptual understanding. As a result, it is appropriate to combine with the education course to produce a good DEG (Lytridis & Tsinakos, 2018). DEG may also consider using the native language as a tool to improve students' academic performance and passion in countries that don't speak English (Zafar et al., 2014). This will assist them in implementing self-directed learning strategies (Toh & Kirschner 2020).

DEG can be used for collaborative learning because including DEG in a module can encourage students to engage with module content throughout the semester by helping them organise their studies, maintain and track their progress (Dowling-Hetherington et al., 2017; Kayyali et al., 2021; Kaimara et al., 2022). Furthermore, DEG development should consider assisting students in making more connections between scientific topics of study and global, sustainability concerns that they encounter in daily life (Mellor et al., 2018).

DEG development should focus on critical elements such as contributing to the development of cognitive skills in students, game specific rules and mechanics, narrative, and aesthetics (Osorio & Ospina, 2021). Students also preferred playing serious games on mobile phones that featured role-playing or strategy game genres, cooperative game styles, and a score system as the reward system (Ng et al., 2021). However, policymakers should support the developer or DEG because there are few incentives to motivate and increase the use of new teaching tools (Calabor et al., 2019).

Conclusion

DEG contributes to critical factors influencing students' learning attitudes and educational intentions. DEG has the potential to motivate students to improve their learning by coming to class well prepared. It also aids in the formation of environmentally conscious attitudes and behaviours in students. Their cognitive, affective, behavioural and social learning improved as a result of the game.

DEG provides an interactive learning environment that combines gaming and learning. DEG has the advantage of being active, experiential and problem-based, as well as providing immediate feedback. It also allows academic staff to identify and assist students in achieving their learning outcomes.

DEG development should focus on contributing to the development of cognitive skills in students. Videos and augmented reality, particularly 3D models have the greatest impact on conceptual understanding. Additionally, integrating learning and gaming modules with augmented reality is a brilliant idea. The benefits of integrating augmented reality in the classroom, particularly in meeting the demands of the Fourth Industrial Revolution, should be the subject of next research.

Acknowledgement

Thank you to all of the authors who contributed significantly to the completion of this paper. A big thank you to members of the Kolej Pengajian Pengkomputeran, Informatik dan Media, Universiti Teknologi MARA (UiTM) Cawangan Pulau Pinang, Kampus Permatang Pauh, Malaysia for their help and support. We express our gratitude to everyone who has assisted us in any way.

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