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Mobile gaming in education: a bibliometric analysis of trends and performance

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Article Info

ABSTRACT

This bibliometric analysis, based on data from the Web of Science (WoS) database, examines the increasing role of mobile gaming in education. Mobile gaming has demonstrated strong potential to improve student engagement, motivation, and cognitive skills, yet research on its integration within formal educational settings is still emerging. By analyzing data from 247 scholarly articles published between 2014 and 2023, this study identifies key trends, influential contributors, and areas of growing interest within this field. The findings reveal a significant rise in publications and citations, underscoring the expanding recognition of mobile gaming's educational value. Prominent themes in the literature include gamification strategies that encourage collaboration, problem-solving, and critical thinking, focusing on multiplayer online battle arenas (MOBAs) and other interactive gaming environments that facilitate active learning. The analysis also highlights leading countries, with the United States at the forefront of research output, alongside significant institutional contributions globally. These insights guide educators and policymakers on leveraging mobile gaming in educational practices while addressing potential challenges. By emphasizing the alignment of mobile gaming with sustainable development goal 4 (quality education), this study establishes a foundation for future research into innovative, technology-enhanced learning solutions that are accessible, engaging, and effective.

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1. INTRODUCTION

Video games are growing in popularity worldwide, and Malaysia is no exception to this growing trend. DataReportal [1] reported that while 75.8% of Malaysians use laptops or computers, a staggering 99.2% are smartphone users, with 81.3% of the population spending an average of one hour per day playing video games on their mobile devices. The mobile gaming industry, in particular, has seen remarkable growth. Global revenue is expected to increase by 9.3% annually, from $169.3 billion in 2020 to over $200 billion in

2023 [2]. With the advancement of mobile technology, which now has computing capabilities that surpass those of earlier supercomputers [3], smartphones have become a powerful platform for communication and entertainment.

Mobile games were originally intended to mimic popular arcade classics using compact designs and limited hardware [4]. However, the COVID-19 pandemic has accelerated the widespread use of smartphones and made them an indispensable tool in daily life [3], [5]. The variety and sophistication of mobile games have also increased with the increasing use of smartphones. According to an insight into video by Medina [6], video games became a popular hobby during the pandemic, with genres such as action, arcade, battle royale, massively multiplayer online role-playing games (MMORPG), multiplayer online battle arenas (MOBA), puzzles, role-playing games and digital card games setting the tone.

Cell phones have not only driven technological innovation but have also made video games mainstream in modern society. This change is closely linked to the rise of casual gaming and gaming culture, which has become an important aspect of modern life [4]. Mobile games improve problem-solving skills and social interaction, making them valuable educational tools [7]. Success depends on effective teamwork and strategic collaboration in the highly competitive MOBA genre. Eaton and Mendonça [8] describe MOBA as a cooperative game that requires sophisticated collaboration where players communicate through various channels, including text and in-game signals.

The wide appeal of MOBA games significantly impacts their players, especially students. Research shows that MOBA players often experience deep engagement, where the game's dynamics capture their full attention, potentially positively impacting their persistence and academic motivation [9]. This immersive environment encourages players to refine their game strategies constantly. In addition, students dedicated to gaming seek challenges to improve their skills, driven by the desire to maintain or improve their rank [10].

Significantly, games have long been recognized as a popular pastime among friends, providing opportunities for social engagement and entertainment [11]. Games, especially mobile games, have evolved into various platforms that serve social, emotional, and cognitive development. Students play video games for various reasons, such as socializing with peers, gaining social status through competition, teaching others how to play, making new friends, and developing leadership skills [3]. The social aspects of this play and technological advances are becoming more intertwined with students' daily lives [12].

With the increasing use of information and communication technology (ICT), students spend more time on these gaming platforms than in the past. The role of technology in education has evolved, providing innovative methods for teaching and learning [13]. The transition from traditional learning methods to a technology-enhanced environment has shown potential benefits. Gamified learning, especially with the help of mobile technology, has generated great interest in engaging students in educational content [14].

One of the most notable examples of gamification in education is Minecraft, a first-person Sandbox game developed by Mojang Studios and published by Microsoft. Since its launch in 2011, Minecraft has become one of the world's most popular and most-played games [15]. Its open-ended nature allows students to try different solutions, encouraging creativity, self-expression, and problem-solving skills. Educators have integrated Minecraft into the classroom to support subjects such as math, history, and science, allowing students to engage in an interactive and immersive learning environment actively [16].

Therefore, mobile games have become an important part of student's lives and offer opportunities and challenges in the context of education. Although video games can promote cognitive development, problem-solving skills, and social interaction, excessive or uncontrolled gaming can have a negative impact on academic performance. Educators and policymakers need to look for ways to harness the positive aspects of mobile gaming while minimizing potential drawbacks to ensure that students can benefit from this technological advancement in a balanced and constructive way.

This bibliometric study aims to provide a comprehensive overview of the existing academic literature on integrating mobile games in an educational context. These research findings are expected to provide valuable insights and evidence for future studies exploring the potential benefits and challenges of integrating mobile gaming technology into learning environments based on the following research questions:
i)   What are mobile gaming research's main trends and themes within educational contexts from 2014 to 2023?
ii) Who are the most influential publications in mobile gaming for education?

2.   METHOD

Bibliometric analysis is important for analyzing and evaluating academic communication and research trends. Using statistical and mathematical techniques, this method quantifies various aspects such as publications, citations, and keywords. The importance of analyzing performance in bibliometric reviews lies in its ability to shed light on academic output and highlight influential works, leading authors, and key institutions, thus revealing critical research gaps. This analysis not only improves the understanding of the

development of mobile game research but also provides insights into emerging trends and potential research paths.

The Web of Science (WoS) database is highly valued for its comprehensive coverage and rigorous indexing standards for bibliometric studies. It is reputation for providing comprehensive citation data across different disciplines has been emphasized in recent research. WoS facilitates the exploration of research trends, current topics, and emerging research fields and enables the identification of highly cited journals. It also supports the mapping of networks in the global scientific literature. Using WoS, researchers can better understand collaboration patterns and thematic groups in various fields, including education and technology. This makes WoS an indispensable resource for researchers who want to analyze the impact and status of research, effectively.

The WoS is still a widely used database for bibliometric analyses, as it is large in size and known for its strict indexing standards. Recent studies continue to emphasize the importance of WoS for bibliometric analysis, especially its ability to provide comprehensive citation data across different disciplines, offering insights into research trends, current topics, and emerging areas of scientific research [17]. In addition, it continues to be a valuable resource for identifying highly cited journals and creating networks across global scholarly publications [18]. Using tools such as VOSviewer, WoS helps scholars explore the state of research, collaboration patterns, and topic clusters in various fields, including education and technology [19]. Using title, abstract, keywords, and topic, the search strategy in Table 1 ensures a comprehensive search for relevant studies. This method allows researchers to cover various topics, such as mobile gaming in education, while focusing on specific citation topics related to the analysis. A comprehensive approach such as this is important for identifying key trends in the literature. Recent studies on bibliometric methodology have also used keyword searches and network mapping to assess thematic connections and emerging trends to ensure high rigor in the selection process [20].

Table 1. Inclusion criteria for bibliometric analysis

WoS database	Type of documents
Time period	2014 to 2023
Search field	Topic
Search keywords	"Mobile gam*" and "educ*"
Citation topics meso	All
Document type	Article or review article
Language	English

3.   RESULTS AND DISCUSSION

Based on data from the WoS database in Figure 1, the bibliometric analysis of mobile games in education shows significant trends and developments from 2014 to 2023. The data consists of 247 articles with 3,733 citations, of which 3,648 citations do not include self-citations. Furthermore, the total number of citations reached 4,273, excluding 4,121 self-citations, resulting in an average of 17.3 citations per article. An H-index of 32 means that at least 32 articles were cited at least 32 times, which emphasizes the influence and importance of this field of research.

A detailed examination of trends from 2014 to 2023 shows a growing interest in mobile games in education. This is reflected in the growing number of publications and the corresponding increase in citations. The steady upward trend indicates a growing recognition of mobile games as an important tool in the educational context, particularly with the potential to enhance learning, promote motivation, and provide interactive and immersive learning experiences. Initially, the number of publications on mobile games in education was modest, possibly reflecting a still new field where the integration of technology in education is still developing.

The average of 17.3 citations per article reflects the academic influence of publications in this area. Considering that the total number of citations is 4,273 (not including 4,121 self-citations), it is clear that research on mobile games in education has attracted much attention in the academic community. An analysis from 2023 underpins the influence of mobile games in education and identifies mobile games as a central theme in gamification efforts that enhance learning across disciplines [21].

In addition, location-based mobile games have been studied for their impact on student engagement, reflecting the depth of research in this area [22]. An H-index of 32 reflects the depth of this field of research and indicates that not only has the number of publications increased, but also the quality and relevance of the research have had a lasting impact on academic discourse. Researchers often refer to key studies, reflecting the robustness of this field, which is constantly evolving and diversifying.
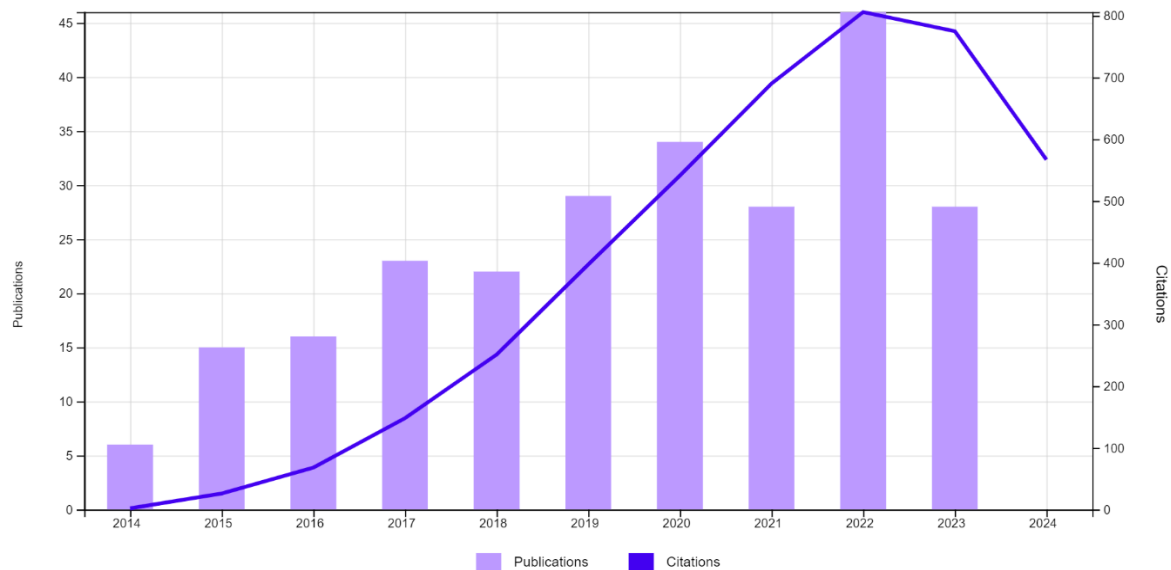
Figure 1. Quantity of publications and citations between 2014 and 2023

Therefore, the increasing role of mobile games in education has gained more attention, especially during the COVID-19 pandemic. The study highlights using mobile games to improve motivation and learning outcomes in the educational context. With the advancement of mobile technology, the accessibility of mobile devices, and the increasing amount of research supporting the benefits of gamification pedagogy and interactive learning, academic attention may have increased. The increasing use of mobile technology and its pedagogical benefits align with this trend [3], [23]. This increase can be linked to the expansion of mobile gaming applications, the development of educational technology, and the growing understanding of how mobile games can support learning outcomes.

3.1. Performance analysis
The analysis of the performance of mobile games in education, as shown by the VOSviewer data, provides a detailed breakdown of the key publications, authors, journals, organizations, and countries contributing to the field. This analysis highlights the growing research interest in the potential of mobile games to improve educational outcomes. It also provides insights into the most influential works, authors, and geographical areas.

3.1.1. Documents
This analysis highlights the 10 most cited documents, as shown in Figure 2, with Hamari *et al*. [24] taking the top spot with 827 citations. This study looks at the role of challenging games in promoting student engagement, flow and immersion and has attracted attention for its empirical investigation of game-based learning in the academic community. In second place is Su dan Cheng [25], with 279 citations, who discusses mobile gamification as a tool to increase motivation and learning success. The focus of these highly cited papers reflects the main themes of research on mobile games, such as engagement, motivation, and learning effectiveness, which continue to drive interest in this area. Several other important publications, including Troussas *et al*. [26] and Furió *et al*. [27], contribute to the broader discussion on mobile game learning, collaboration, and its impact on traditional educational methods. These papers highlight various applications of mobile games that span higher education, language learning, and virtual reality (VR) environments.
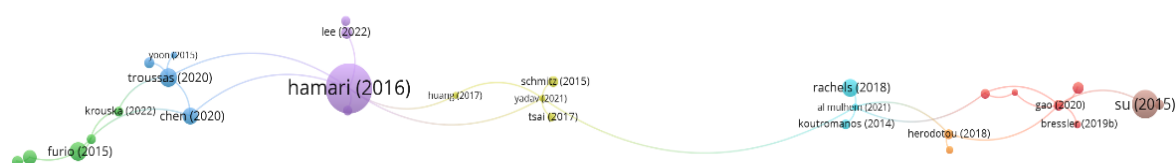

Figure 2. Most cited documents

3.1.2. Authors

In terms of individual contributions in Figure 3, Patcharin Panjaburee and Lucia Pombo lead the way with four papers each and significant overall link strength, emphasizing their influence in the mobile games research network. For these authors, advancing research on how mobile games can be used in an educational context is important. Their work often focuses on integrating gamification into curriculum design and assessing learning outcomes through mobile platforms. Other influential authors include Abriti Arjyal and Sushil Baral, who have significantly contributed to the growing literature, particularly in the context of mobile game pedagogy applications. The overall strong linkage of these authors shows that their work is well-connected and frequently referenced within a wider research network.
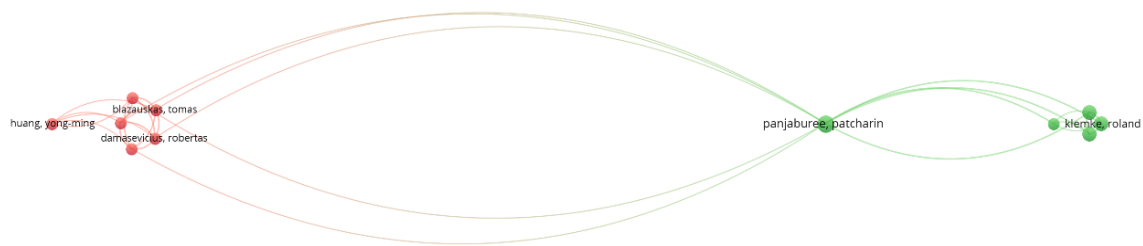
Figure 3. Author contributions

3.1.3. Institutions

The performance analysis also highlights the key organizations contributing to research on mobile games. Mahidol University and Aveiro University are the most prolific, with Mahidol University contributing five papers and collecting 60 citations. The contributions of these institutions in Figure 4 reflect regional research centers, particularly in Asia and Europe, advancing the understanding of the role of mobile games in education. Institutions such as the University of Eastern Finland and the National Yunlin University of Science and Technology also stand out, with the latter demonstrating its influence in this area with 399 citations in four documents. These institutions often collaborate across borders, facilitating the global expansion of research into mobile games for educational purposes.
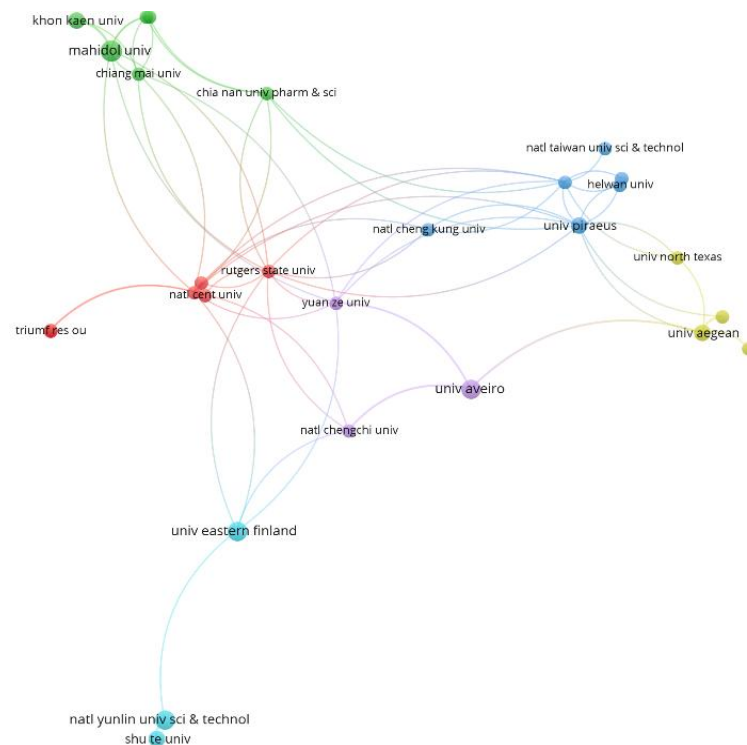

Figure 4. Key organization

3.1.4. Countries

Geographically, the United States is the leader in mobile gaming research, with 50 documents and 1,485 citations. This high number of citations in Figure 5 reflects a strong academic infrastructure in the US and a prioritization of innovative educational technology. Taiwan ranks second with 25 documents and 759 citations, while China, Turkey, and the United Kingdom are major contributors. These countries have made significant contributions in this area, with researchers exploring various aspects of mobile gaming, from gamification techniques to integrating mobile games into formal and informal learning environments. This global distribution of research emphasizes the widespread interest in mobile games to enhance education, with different cultural and pedagogical contexts influencing the scope and direction of research. Contributions from Greece, Spain, and Australia emphasize the international interest in mobile games and highlight their importance in different educational systems.
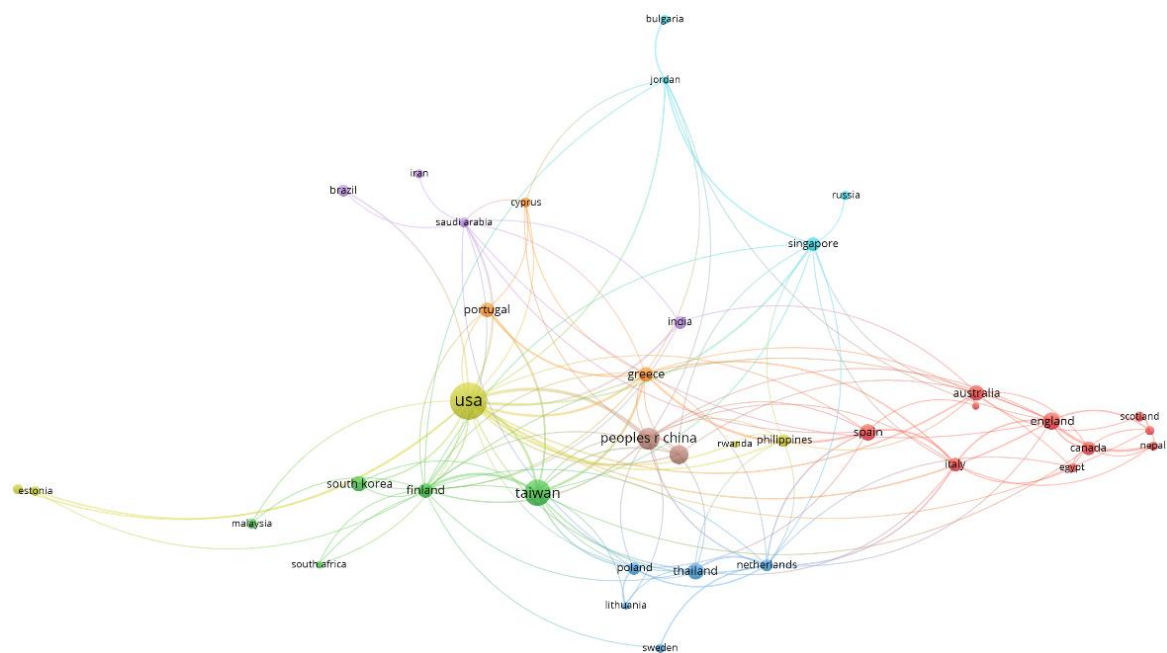
Figure 5. Citations by countries

3.1.5. Sources

Journal performance data in Figure 6 shows that education and information technologies and computers and education are the top two sources for research on mobile games in education. Computers and education has the highest number of citations with 378 citations from eight papers, emphasizing it is significant role in disseminating important research findings. These journals are highly regarded in educational technology, and their importance in this analysis emphasizes the interdisciplinary nature of mobile games research, which often overlaps with educational technology, pedagogy, and cognitive science. Other journals, such as the Journal of Computer Assisted Learning and JMIR Serious Games, are also strongly represented, indicating diverse publication outlets for mobile game research. The diversity in this source reflects the interdisciplinary nature of this study, with findings relevant to both the education and healthcare sectors, such as mobile games to support chemotherapy patients [28].

3.2. Discussion

The findings of this bibliometric analysis underscore the growing importance of game-based learning in education, highlighting a need for strategic integration to enhance student engagement and performance. Game-based platforms can offer immersive learning experiences that resonate with students' digital literacy levels when designed with user-friendly interfaces and clear educational objectives. For this integration to be effective, educational stakeholders—including curriculum designers, policymakers, and educators—must prioritize mobile learning environments that support well-defined learning objectives and align with specific curriculum standards [29], [30].
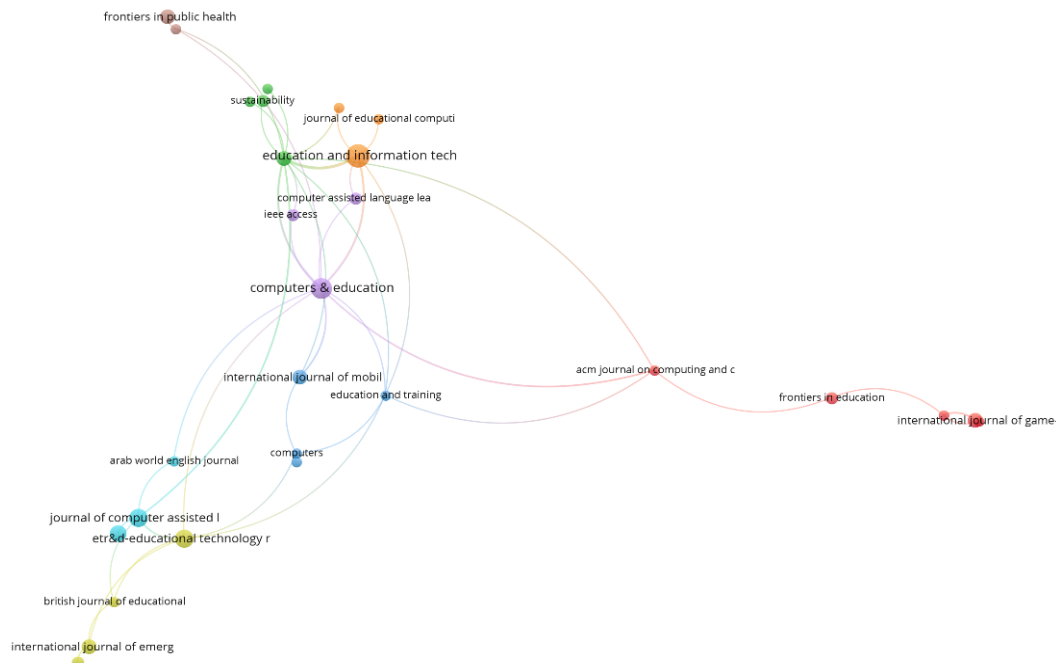
Figure 6. Journal performance

As reflected in the analysis, motivation and gamification are increasingly essential for engaging today's students, especially in contexts where traditional engagement strategies may fall short. Research by Hamari *et al.* [24] demonstrates that carefully designed educational games can foster active learning by tapping into students' intrinsic motivation. Consequently, schools and universities should consider embedding game-based elements in curricula for entertainment and to promote deeper learning, particularly in complex subjects such as science, technology, engineering, and mathematics (STEM). Serious games and augmented reality (AR) applications offer students hands-on experiences in subjects like science, history, and geography, transforming abstract concepts into concrete learning activities that enhance retention and comprehension.

Mobile game-based learning is also promising for bridging educational gaps, especially in underserved or rural areas. With mobile devices increasingly ubiquitous, they offer a practical channel for delivering educational content to students with limited access to traditional resources. Previous studies [31], [32] suggested that mobile learning tools can help level the playing field by providing flexible access to quality education anytime, anywhere. To fully capitalize on this potential, educators and developers should focus on creating mobile-compatible educational games and applications designed for varied socioeconomic contexts, ensuring broader reach and inclusivity.

Moreover, mobile games have shown potential beyond traditional learning by offering supportive mental and physical well-being interventions. Research indicates that mobile games can help students manage stress, anxiety, and other mental health challenges when used as health tools. Games designed for behavior modification, such as those discussed by Baranowski *et al.* [33], can be particularly effective as therapeutic aids within formal and informal educational settings. This positions mobile gaming as an academic tool and a supportive resource for promoting holistic student well-being.

Implementing game-based learning also calls for new, adaptive assessment strategies. Traditional assessments often fall short of capturing the breadth of skills developed through game-based learning, such as problem-solving, critical thinking, and collaboration [34]. Fu *et al.* [35] have developed engagement metrics tailored to e-learning games, which help educators assess student experiences beyond academic outcomes. For game-based learning to be genuinely impactful, educators need flexible assessment methods that provide real-time feedback and performance tracking. Such assessments can bridge the gap between traditional metrics and game-based learning environments' dynamic, collaborative nature, aligning evaluation with 21st-century educational goals.

4. CONCLUSION

The implications of this bibliometric analysis are important. This discovery suggests that frameworks for game-based learning, gamification, mobile learning, and serious games need to adapt to new technologies

and their impact on student engagement and learning outcomes. Educational institutions and practitioners should focus on the development and implementation of mobile learning tools and games that utilize this latest technology to improve student motivation, engagement and performance. In addition, the integration of game-based interventions for mental and physical health are important for future research and practice. This bibliometric analysis shows that research on mobile games for educational purposes will continue to increase. Considering the trend showing a continuous increase in both publications and citations, it is expected that emerging technologies such as AR mobile games and VR will further contribute to the literature.

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Rita Wong Mee Mee	✓		✓			✓			✓		✓		✓	
Walton Wider	✓	✓			✓				✓			✓		
M. Zaini Miftah	✓			✓	✓		✓			✓				
Jun S. Camara		✓		✓		✓				✓	✓			

C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis

I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting

Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

Data availability is not applicable to this paper as no new data were created or analyzed in this study.

REFERENCES

[1] S. Kemp, "Digital 2021: Malaysia," 2021. Accessed Sep. 26, 2024. [Online]. Available: https://datareportal.com/reports/digital-2021-malaysia?rq=malaysia
[2] V. Bobrov, "Analysis of the current state of national mobile games markets," *Bulletin of V. N. Karazin Kharkiv National University Economic Series*, no. 103, pp. 97–103, Dec. 2022, doi: 10.26565/2311-2379-2022-103-12.
[3] Y. Li, Z. Xu, Y. Hao, P. Xiao, and J. Liu, "Psychosocial Impacts of Mobile Game on K12 Students and Trend Exploration for Future Educational Mobile Games," *Frontiers in Education*, vol. 7, p. 843090, Apr. 2022, doi: 10.3389/feduc.2022.843090.
[4] F. Mäyrä and K. Alha, "Mobile Gaming," in *The Video Game Debate 2: Revisiting the Physical, Social, and Psychological Effects of Video Games*, R. Kowert and T. Quandt, Eds., New York: Routledge, 2020, pp. 107–120.
[5] P. S. P. Omarali, "Considerations of Game Dynamics and Mechanics in College Students' Use of Mobile Games for Learning," *International Journal of Mobile and Blended Learning*, vol. 14, no. 2, pp. 1–12, Sep. 2022, doi: 10.4018/IJMBL.309739.
[6] X. S. Medina and M. S. Medina, "Video Games and the COVID-19 Pandemic: Virtual Worlds as New Playgrounds and Training Spaces," *COVID*, vol. 4, no. 1, pp. 1–12, Dec. 2023, doi: 10.3390/covid4010001.
[7] A. Ab Rahman, M. H. Saleh, A. M. Ahmad, Z. Daud, and M. F. Abd. Shakor, "The Effectiveness of Global Tahfiz Game (GTG) Gamification in Teaching and Learning in Malaysia," *Malaysian Journal of Social Sciences and Humanities (MJSSH)*, vol. 7, no. 10, p. e001785, Oct. 2022, doi: 10.47405/mjssh.v7i10.1785.
[8] J. A. Eaton and D. J. Mendonça, "Linking adaptation processes to team performance in high-tempo, high-stakes teamwork: a large-scale gaming perspective," *Theoretical Issues in Ergonomics Science*, vol. 20, no. 6, 2019, doi: 10.1080/1463922X.2019.1594444.
[9] W. M. I. F. W. Ahmad, S. M. Mohd, A. N. A. Wahab, N. M. Jan, S. Kamarudin, and H. Kaco, "Online game: current trend among Malaysian secondary school's student," *International Journal of Education, Psychology and Counseling*, vol. 7, no. 45, pp. 492–500, Mar. 2022, doi: 10.35631/IJEPC.745037.
[10] J. R. N. de los Santos, E. E. C. Cornillez Jr., V. D. Carillo Jr., and G. N. de los Santos, "Mobile Games and Academic Performance of University Students," *International Journal of Innovative Technology and Exploring Engineering*, vol. 9, no. 4, pp. 720–726, Feb. 2020, doi: 10.35940/ijitee.A4788.029420.

[11] F. J. Tuggle, J. Kerpelman, and J. Pittman, "Young Adolescents' Shared Leisure Activities with Close Friends and Dating Partners," *Journal of Leisure Research*, vol. 48, no. 5, pp. 374–394, Nov. 2016, doi: 10.18666/JLR-2016-V48-I5-6899.

[12] D. Berry, "Level-up learning: Video games in an online class," *TESL-EJ*, vol. 25, no. 1, pp. 1–24, 2021.

[13] Y. Lin and Y. Liu, "An Empirical Study on the Influence of Mobile Games and Mobile Devices for Contemporary Students' Education and Learning Behavior," *Journal of Organizational and End User Computing*, vol. 34, no. 8, pp. 1–25, Dec. 2022, doi: 10.4018/JOEUC.315620.

[14] G. Lampropoulos, E. Keramopoulos, K. Diamantaras, and G. Evangelidis, "Integrating Augmented Reality, Gamification, and Serious Games in Computer Science Education," *Education Sciences*, vol. 13, no. 6, Jun. 2023, doi: 10.3390/educsci13060618.

[15] B. Simon and D. Wershler, "Childhood's End (or, We Have Never Been Modern, Except in Minecraft)," *Cultural Politics*, vol. 14, no. 3, pp. 289–303, Nov. 2018, doi: 10.1215/17432197-7093310.

[16] L. Martinez, M. Gimenes, and E. Lambert, "Entertainment video games for academic learning: a systematic review," *Journal of Educational Computing Research*, vol. 60, no. 5, pp. 1083–1109, Sep. 2022, doi: 10.1177/073563331211053848.

[17] P. Savas, "Online education research trends in science education: content and bibliometric mapping analysis," *i-Manager's Journal of Educational Technology*, vol. 19, no. 2, p. 43, 2022, doi: 10.26634/jet.19.2.19113.

[18] D. Wang, "Bibliometric analyses and network mapping on the smart library in Web of Science from 2003 to 2021," *Library Hi Tech*, vol. 42, no. 5, pp. 1601–1633, Oct. 2024, doi: 10.1108/LHT-08-2022-0361.

[19] E. I. Wilder and W. H. Walters, "Using Conventional Bibliographic Databases for Social Science Research: Web of Science and Scopus are not the Only Options," *Scholarly Assessment Reports*, vol. 3, no. 1, p. 4, Aug. 2021, doi: 10.29024/sar.36.

[20] S. Liang, "Trend Analysis of Journal of Finance Based on Web of Science Database," *Journal of Physics: Conference Series*, vol. 1852, no. 4, p. 042010, Apr. 2021, doi: 10.1088/1742-6596/1852/4/042010.

[21] R. Chugh and D. Turnbull, "Gamification in education: A citation network analysis using CitNetExplorer," *Contemporary Educational Technology*, vol. 15, no. 2, p. ep405, Apr. 2023, doi: 10.30935/cedtech/12863.

[22] F. R. Ribeiro, A. Silva, A. P. Silva, and J. Metrôlho, "Literature Review of Location-Based Mobile Games in Education: Challenges, Impacts and Opportunities," *Informatics*, vol. 8, no. 3, p. 43, Jun. 2021, doi: 10.3390/informatics8030043.

[23] A. Krouska, C. Troussas, and C. Sgouropoulou, "Mobile game-based learning as a solution in COVID-19 era: Modeling the pedagogical affordance and student interactions," *Education and Information Technologies*, vol. 27, no. 1, pp. 229–241, Jan. 2022, doi: 10.1007/s10639-021-10672-3.

[24] J. Hamari, D. J. Shernoff, E. Rowe, B. Coller, J. Asbell-Clarke, and T. Edwards, "Challenging games help students learn: An empirical study on engagement, flow and immersion in game-based learning," *Computers in Human Behavior*, vol. 54, pp. 170–179, Jan. 2016, doi: 10.1016/j.chb.2015.07.045.

[25] C. Su and C. Cheng, "A mobile gamification learning system for improving the learning motivation and achievements," *Journal of Computer Assisted Learning*, vol. 31, no. 3, pp. 268–286, Jun. 2015, doi: 10.1111/jcal.12088.

[26] C. Troussas, A. Krouska, and C. Sgouropoulou, "Collaboration and fuzzy-modeled personalization for mobile game-based learning in higher education," *Computers & Education*, vol. 144, p. 103698, Jan. 2020, doi: 10.1016/j.compedu.2019.103698.

[27] D. Furió, M. -C. Juan, I. Seguí, and R. Vivó, "Mobile learning vs. traditional classroom lessons: a comparative study," *Journal of Computer Assisted Learning*, vol. 31, no. 3, pp. 189–201, Jun. 2015, doi: 10.1111/jcal.12071.

[28] H. J. Kim, S. M. Kim, H. Shin, J.-S. Jang, Y. I. Kim, and D. H. Han, "A Mobile Game for Patients with Breast Cancer for Chemotherapy Self-Management and Quality-of-Life Improvement: Randomized Controlled Trial," *Journal of Medical Internet Research*, vol. 20, no. 10, p. e273, Oct. 2018, doi: 10.2196/jmir.9559.

[29] M. Qian and K. R. Clark, "Game-based Learning and 21st century skills: A review of recent research," *Computers in Human Behavior*, vol. 63, pp. 50–58, Oct. 2016, doi: 10.1016/j.chb.2016.05.023.

[30] K. D. Squire and M. Jan, "Mad City Mystery: Developing Scientific Argumentation Skills with a Place-based Augmented Reality Game on Handheld Computers," *Journal of Science Education and Technology*, vol. 16, no. 1, pp. 5–29, Feb. 2007, doi: 10.1007/s10956-006-9037-z.

[31] G.-J. Hwang, P.-H. Wu, and C.-C. Chen, "An online game approach for improving students' learning performance in web-based problem-solving activities," *Computers & Education*, vol. 59, no. 4, pp. 1246–1256, Dec. 2012, doi: 10.1016/j.compedu.2012.05.009.

[32] G. Schwabe and C. Göth, "Mobile learning with a mobile game: design and motivational effects," *Journal of Computer Assisted Learning*, vol. 21, no. 3, pp. 204–216, Jun. 2005, doi: 10.1111/j.1365-2729.2005.00128.x.

[33] T. Baranowski, R. Buday, D. I. Thompson, and J. Baranowski, "Playing for Real," *American Journal of Preventive Medicine*, vol. 34, no. 1, pp. 74-82, Jan. 2008, doi: 10.1016/j.amepre.2007.09.027.

[34] J. M. Bryce, R. Thinakaran, and Z. A. Zakaria, "Knowledge Management Applied to Learning English as a Second Language Through Asynchronous Online Instructional Videos," *Journal of Information Technology Education: Innovations in Practice*, vol. 21, pp. 115–133, 2022, doi: 10.28945/5016.

[35] F.-L. Fu, R.-C. Su, and S.-C. Yu, "EGameFlow: A scale to measure learners' enjoyment of e-learning games," *Computers & Education*, vol. 52, no. 1, pp. 101–112, Jan. 2009, doi: 10.1016/j.compedu.2008.07.004.

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