IJIS Edu : Indonesian J. Integr. Sci. Education, 7 (1) 2025

Volume 7 Issue 1 , Januari 2025
P-ISSN: **2655-2388**, E-ISSN: **2655-2450**

Designing Educational Games with Mastery Learning Strategy to Improve Computational Thinking Skills: A Bibliometric Analysis

Emilia Candrawati[1,3], Ijang Rohman[1*], Ratnaningsih Eko Sardjono[1], Binar Kurnia Prahani[2], and Satwika Trianti Ngandoh[1]

[1] *Universitas Pendidikan Indonesia, West Java, Indonesia*
[2] *Universitas Negeri Surabaya, East Java, Indonesia*
[3] *Universitas Bengkulu, Bengkulu, Indonesia*
Corresponding E-mail: ijangrh@upi.edu

Abstract: Students need computational thinking skills to help them face global challenges with rapid technological development. For this reason, teachers must be able to implement CT in learning by paying attention to students' interest in learning, one of which is using educational games. Designing CT-integrated educational games requires appropriate strategies such as mastery learning. This study aims to analyse the development of educational game design using mastery learning strategies so that it can provide an overview to educators in developing the media to improve students' CT skills. This research uses a qualitative descriptive method. The data obtained was analysed bibliometrically using the VOS Viewer application. The VOS Viewer analysis shows that there is a connection between game design, computational thinking, and mastery learning that began in 2016. The results also show that there are 4 things that become the basis for designing educational games, namely cognitive, motivational, affective, and sociocultural perspectives..

Keywords: Educational Games, Mastery Learning Strategy, Computational Thinking

How to cite this article :

Candrawati, E. (2025). Designing Educational Games with Mastery Learning Strategy to Improve Computational Thinking Skills: A Bibliometric Analysis. *IJIS Edu : Indonesian Journal of Integrated Science Education, 7*(1). doi:http://dx.doi.org/10.29300/ijisedu.v7i1.5102

1. Introduction

The curriculum in Indonesia is always undergoing improvements by following the development of science and technology in order to equip students to be able to answer global challenges. This improvement is manifested by the presence of the Independent Learning-Independet Campuses (i.e. MBKM) curriculum which focuses more on mastering 21st century life skills. One of the life skills in question is computational thinking skills (Candrawati, Uliyandari, Rustaman, & Kaniawati, 2022). Computational thinking was popularized by Wing (2006) who described CT as problem solving, system design, and understanding human behavior by drawing on fundamental concepts for computer science. But then, CT is no longer only for computer science, but in other fields of science (Kraska, 2020). Alyahya and Alotaibi (Alyahya & Alotaibi, 2019) also said that computational thinking is a cross-curricular topic that can be integrated into the curriculum itself.

The implementation of CT according to Malik (2017) must pay attention to the interest of students in learning by using interactive learning media. One of the learning media that is considered to be able to encourage the development of students' computational thinking is educational games. Vahldick (2020) states that the purpose of games in an educational context is to create motivation and an attractive atmosphere in learning because students will be rewarded if they successfully complete the challenges in the game so that they are trained to find solutions to the problems encountered. This means that games as learning media can provide a special attraction that encourages increased student motivation to learn. López et al. (2016) and Chau et al. (2015) also mentioned that games and their development have been used as a strategy to promote learning. Research conducted by Silvana (2021) shows that there is a significant difference between the pretest and posttest scores after utilizing the learning process with the "Script Labyrinth" game. The educational game itself is interpreted as a medium that integrates subject matter into game components (Riva, 2012).

Designing educational games is not easy (Silva, 2020). The process of designing an educational game needs a lot of planning and requires a lot of skills (Hussein, Ow, Cheong, & Thong, 2019). Here, the game must be adapted to the material and purpose of the lesson. One of the learning strategies that can underlie the design of educational games is mastery learning, namely a learning strategy with the aim that most students can master the learning objectives completely (Francis, Ezenkiri, & Enock, 2022). Mukhtar (2020) defines mastery learning as a learning approach by adhering to the principle of mastery learning with benchmarks used in achieving learning outcomes. Complete learning ensures comprehensive learning outcomes, allowing learners to progress only after mastering each level of content (Winget &

Online ISSN 2655-2450 | Print ISSN 2655-2388

Persky, 2022) . With a mastery learning strategy, educational games are designed to challenge students to achieve their learning goals completely. Likewise with educational games whose game components are integrated with computational thinking. Where, students are considered to have achieved learning objectives if they have successfully completed a game that contains elements of CT. This, in turn, fosters CT skills, such as decomposition, abstraction, pattern recognition and algorithmic thinking (Hunsaker, 2020); (Grover & Pea, 2013)). Research also underscores the compatibility of mastery learning with game-based education, as students receive immediate feedback and adjust their approach until they achieve the desired outcome (Lin, et al., 2013). This is in line with Bloom's (1984) findings, which state that mastery learning improves knowledge retention and application.

Previous researchers have paid great attention to the implementation of CT, resulting in several systematic reviews of strategies used to teach CT, one of which is game-based. However, issues related to the design of educational games integrated with computational thinking have not been discussed in depth. This also provides information that effective strategies that can be used in designing CT-integrated educational games have not really been found. For this reason, it is necessary to map scientific knowledge and recognize the development of research related to this matter so that practitioners and academics get logical knowledge that can be applied when designing CT-integrated educational games.

One way to map scientific knowledge is bibliometrics. This method is a literature analysis that is widely used by researchers these days. Bibliometrics is a study of bibliographic analysis of scientific activities, focusing on the analysis of published data (Prahani, et al., 2022); (Tupan, Rahayu, Rachmawati, & Rahayu, 2018). Using bibliometric analysis, this study seeks to map out effective strategies for integrating CT, educational games and flipped learning. This bibliometric study provides a framework for integrating these themes.

2. Method

This research uses bibliometric analysis to map scientific knowledge about educational game design integrated with computational thinking. It provides a quantitative assessment of scholarly output within a particular field or discipline. By analyzing publication data, citations, and other bibliographic indicators, it is possible to gain insights into trends and the impact of research outputs over time (Guzsvinecz & Szelinger, 2024). The bibliometric steps taken include the following five steps ((Putri, Syahmani, & Prasetyo, 2023); (Setyaningsih, Indarti, & Jie, 2018); (Hossain, Dayarathna, Nagahi, & Jaradat, 2020); (Ria, 2024)) as presented in figure 1.

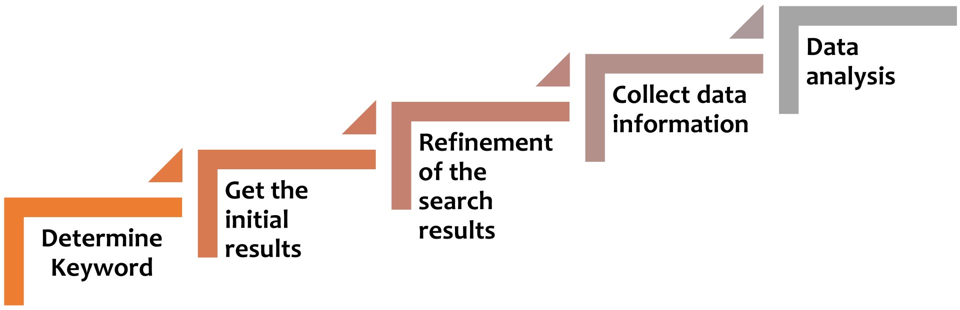

Figure 1. Bibliometric Analysis Workflow

To search the initial data, the researcher used the keywords "educational game", "computational thinking", "mastery learning", and "designing game" with the help of publish or perish software in 10 years (2013-2022). All data were saved in .ris file format. Initial statistics using VOSViewer software with the selected data to reveal the network visualisation of the keywords obtained from the metadata ((Shen, et al., 2023); (Ji, et al., 2023). VOSviewer is effectively used in analysing bibliographic data and produces in-depth data analytical output in the form of mapping visualisations, in example netwokrs, overlay, and densities (Hidayat, Patras, Usman, Gunawan, & Windiyani, 2023). These results were then descriptively re-analysed in terms of clusters of keywords, year of publication, affiliation, publication type, and number of citations.

3. Result and Discussion

Analysis of Trends

The data results from VOSViewer show that there are 4,292 terms with 128 meet the threshold. After being analyzed, the data is separated into 3 clusters that have interrelated keywords. The following is a cluster table from the results of data analysis with VOSViewer.

Table 1. Keywords Representing Each Cluster

Cluster 1	Cluster 2	Cluster 3
Algorithmic thinking	Challenge	Child
Computational thinking	Educational game	Concept
Game development	Game	
Master	Game design	
Paper	Game designer	
Problem	Learning	
Programming	Mastery	
Teacher	Serious game	
Teaching		

Online ISSN 2655-2450 | Print ISSN 2655-2388

The network visualization in VOSViewer shows the relationship between keywords and published articles. Color differences indicate cluster differences (Ji, et al., 2023). Below is a network visualization of data analysis results in VOSViewer (Figure 2).

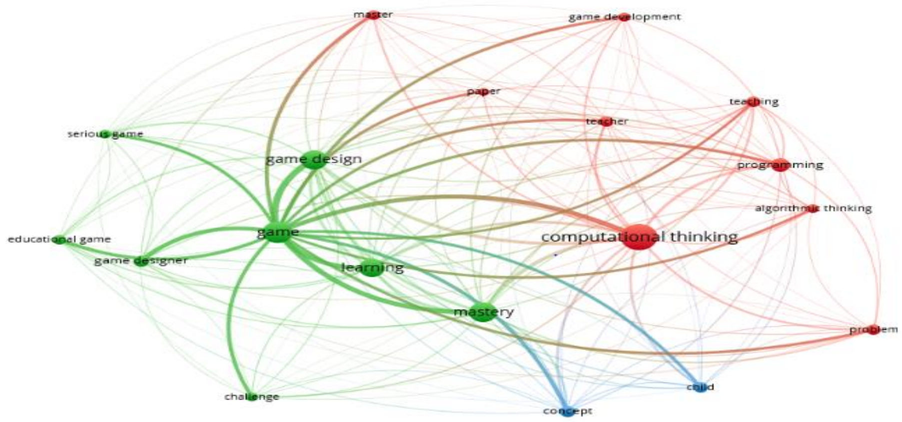

Figure 2. The Network Visualization In Game Educational, Mastery Learning, And Computational Thinking Study

Figure 2 above shows that there is a close relationship between games, game design, and computational thinking. This is in line with the research conducted by Troiano et al. (Troiano, et al., 2019) which assessed the development of students' computational thinking from game design with Scratch. The results of this study show how game design in the STEM curriculum leads to computational thinking skills. Meanwhile, research by Ch'ng et.al (2019) shows that the most common approach used for learning computational thinking is the use of games as programming and reflective systems through the development of serious games. This relationship is also seen in the keywords that are most often found in articles that are included in cluster 1.

Besides being related to computational thinking, educational games and game design are also related to mastery learning strategies. These three keywords are included in cluster 2. The study of the implementation of game-based learning with mastery learning strategies conducted by Lin et al. (2013) showed that mastery learning is very well used for reflection and remedial, where every time students cannot answer questions with correct then they will receive instructions for immediate repair. In the concept of game-based learning, the mastery learning strategy makes students unable to continue the game before they can complete the questions or challenges of the game at the previous level.

Analysis based on overlay visualization (Figure 3) shows that the study of games started in early 2015 with a focus on games, some educational games, and serious games. Then in mid-2016, research on games began to lead to mastery learning strategies. Research on games continues to grow until approaching 2018 starting to be associated with computational thinking.

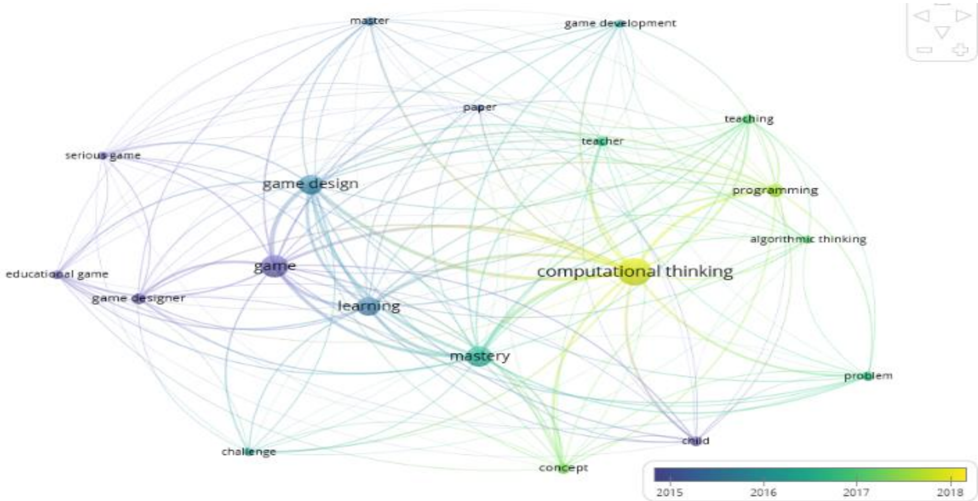

Figure 3. Overlay Visualization in Game Educational, Mastery Learning, and Computational Thinking Study

The analysis based on the overlay visualisation also shows that the current research trend still around the relationship between game design and computational thinking, for various levels of education. The yellow colour on the computational thinking keyword indicates that the research on the topic is still relatively new, so it is possible to obtain novelty. Although the strategy of thorough learning was found to be related to game design, it was not associated with computational thinking. This shows that there is still a great opportunity for researchers, educators, and librarians to conduct further research linking game design, mastery learning strategies, and computational thinking. Research related to them will be better if it is directed at the scope or field of science.

The top ten authors for papers containing the keywords "educational game", "computational thinking", "mastery learning", and "designing game" are dominated by authors of articles and books. Almost all authors who are included in the top ten authors write about designing games. The following is a table of the top ten authors (table 2).

Online ISSN 2655-2450 | Print ISSN 2655-2388

Table 2. Top Ten Authors

Authors	Year	Total citation	Publication type
J Hamari	2016	5.175	Article
L Berk	2015	4.926	Book
A Collins	2018	2.272	Book
K Seaborn, DI Fels	2015	2.216	Article
A Dominguez	2013	2.123	Article
E Adams	2014	2.016	Book
D Laurillard	2013	1.869	Article
P Wouters	2013	1.667	Article
AJ Romiszowski	2016	1.584	Book
S Nicholson	2015	1.576	Article

Hamari et.al (2016) as the author whose article was most cited suggested that designing educational games by paying attention to game challenges that can follow the development of learners to support continuous learning in game-based learning environments. While Plass, Homer, and Kinzer (Plass, Homer, & Kinzer, 2015) mentioned there are 4 things that become the basis in designing learning games, namely cognitive, motivational, affective, and sociocultural perspectives. According to Plass et.al (2015) a combination of cognitive, motivational, affective, and sociocultural perspectives are needed for game design and game research to capture what games are appropriate for learning. Here, game-based learning is viewed as a series of learner engagements at multiple levels (cognitive, affective, behavioural, and sociocultural), and treats game design elements as strategies to achieve these engagements based on established cognitive, affective, motivational, and sociocultural foundations. Recent studies by Brinson et al. (2020), Kiili et al. (2022), and Hamari et al. (2016) further validate that incorporating these dimensions improves engagement and learning outcomes in game-based environments. In addition, Wouters et al. (2013) found that serious games are highly effective in improving retention and application of complex knowledge when paired with mastery learning strategies.

Other studies, including those by Ernest Adams (2014), have shown how educational games provide narrative structure and immersive experiences that deepen conceptual understanding. In addition, Saavedra and Opfer (2012) emphasized the need to integrate 21st century skills, such as CT, into the curriculum through innovative methods such as game-based learning. Recent bibliometric reviews by Connolly et al. (2012) and Arnab et al. (2012) further highlight the positive effects of educational games on learning outcomes across various disciplines. Studies by Sabourin et al. (2013) and Shute et al. (2017) emphasize adaptive learning mechanisms in educational games to optimize skill acquisition. Meanwhile, Kirriemuir and McFarlane (Kirriemuir & McFarlane, 2004) provide basic insights into the potential of serious games in education, a point further elaborated by Young et al. (2012) on their cross-disciplinary impact.

Key for Design Educational Games with Mastery Learning

It was previously mentioned that designing educational games must pay attention to four basic things, namely the perspectives of cognitive, affective, motivation, and socioculture. These four must be well integrated into each component of the educational game. The main component of an educational game is to provide engagement and challenge to the user in an effort to solve the problems in the game. Researchers consider game-playing as a problem-solving process ((Jiang, Harteveld, Huang, & Fung, 2019); (Ke, 2016)).

Based on a cognitive perspective, educational games should include elements that encourage problem-solving, algorithmic thinking, and pattern recognition. Cheng, et al. (2023) showed that a game-based approach can improve students' computational thinking skills by providing structured challenges in the form of relevant tasks. In addition, Mayer (2024) explained that multimedia design elements, such as animation and interactive feedback, can improve students' cognitive processing in educational games.

This approach is relevant to mastery learning strategies that require students to master concepts before moving on to the next level (Heintz, Mannila, & Färnqvist, 2016). In this design, the challenges students face should support deep understanding and gradual application of knowledge.

While affective involves students' emotions and engagement with the content. Emotionally relevant narratives and characters are one of the functions of game elements (Alexiou & Schippers, 2018). In addition, the growth mindset facilitated by games can increase students' intrinsic motivation to continue learning ((Ng, 2018); (O'Rourke, Haimovitz, Ballweber, Dweck, & Popović, 2014)). González, et al. (2018) notes that the emotional elements integrated in games, such as positive feedback and rewards for success, provide a sense of achievement that motivates students to stay engaged.

Motivation in games can be influenced by a combination of intrinsic and extrinsic elements (Stéphanie, et al., 2022). According to Lee and Hammer (Lee & Hammer, 2011), Educational games that uses elements such as points, badges and levels can motivate students to achieve learning goals (Diniz, Silva, Gerosa, & Steinmacher, 2017) . This strategy is in line with the principle of mastery learning which motivates students to master each step in the learning process (Winget & Persky, 2022). Education-based games should provide relevant challenges and meaningful rewards. Peery and Pasalar (2018) note that serious game design should create learning experiences focused on mastering the material.

Beyond cognitive, affective, and motivational perspectives, game design should also reflect learners' culture and social context. Jenkins (2007) emphasizes the importance of cultural representation in interactive media, which allows students to feel relevant to the material being taught. This is reinforced by Martin and Bolliger

Online ISSN 2655-2450 | Print ISSN 2655-2388

(2018), who show that social engagement in game-based learning can increase learning effectiveness. Collaborative approaches that utilize social dynamics in games, as described by Barab, Gresalfi, and Ingram-Goble (2011), allow students to work together to solve problems, reflecting sociocultural values.

In addition to the four perspectives above, immediate feedback is also an important element in the design of educational games that support mastery learning strategies (Li, Chen, & Deng, 2024). Bimba et al. (2021) showed that adaptive feedback can accelerate student learning by providing clear guidance on what needs to be improved. Shute et al. (2017) also emphasized the importance of iterative problem solving, where students can try different approaches until they find the right solution. This process not only improves students' understanding but also their confidence in facing new challenges (Bandura, 1997).

Educational games should also be designed to be accessible to learners with diverse backgrounds and abilities. Silva (2020) emphasized that games should include adjustable difficulty levels to accommodate the needs of different students. In addition, Cheung and Slavin (Cheung & Slavin, 2013) noted that well-integrated educational technology can improve academic achievement in various contexts.

Opportunities for Future Research

Although flipped learning strategies and CT integration in games show promising results, there are still gaps in customizing these designs to specific educational contexts. Further research should explore interdisciplinary approaches and specific applications in the field. Future research should consider diversity in learner profiles and the cultural relevance of game content to optimize effectiveness (Jossan, Gauthier, & Jenkinson, 2021). Studies such as Dominguez et al. (2013) emphasize that gamification approaches benefit greatly from contextual adaptability to different levels of education and fields of study.

Recent studies also highlight the potential of incorporating artificial intelligence (AI) to enhance personalized learning experiences in game-based learning environments. For instance, Akavova et al. (2023) discussed how adaptive AI systems can tailor challenges and feedback to individual learners' needs, significantly improving engagement and learning outcomes. Additionally, Udeozor et al. (2023) explored the integration of VR and AR technologies in educational games, revealing their capability to provide immersive and interactive experiences that support complex cognitive skill development.

Another promising direction is the use of data analytics to monitor and optimize students' learning paths within educational games. Research by Minović and Milovanović (2013) demonstrated how real-time analytics could help educators adjust game parameters to better align with educational objectives. This approach not only enhances the efficacy of game-based learning but also provides valuable insights into students' learning behaviors.

Future research should also address the sustainability and accessibility of game-based learning designs. In addition, research is also needed that emphasizes the importance of developing low-cost, scalable educational games that can be implemented in resource-constrained educational settings. By addressing this gap, researchers can further refine the integration of computational thinking, flipped learning strategies and game design to create more effective and inclusive educational tools.

4. Conclusion

This research reveals that educational game design integrated with mastery learning strategies has great potential in improving students' computational thinking skills. Bibliometric analysis showed significant developments since 2015, with a focus on the relationship between educational games, mastery learning strategies and computational thinking that began to be established in 2018. Effective educational game design should consider four key dimensions-cognitive, motivational, affective and sociocultural-to create a well-rounded learning experience. Nonetheless, there is still a research gap in the integration of these aspects, especially in various educational and cultural contexts, which opens up great opportunities for future research. This research provides a useful conceptual framework for practitioners and academics in developing innovative learning media to prepare students for global challenges.

References

Adams, E. (2014). *Fundamentals of Game Design, Third Edition.* United States of America: Pearson Education.

Akavova, A., Temirkhanova, Z., & Lorsanova, Z. (2023). Adaptive learning and artificial intelligence in the educational space. *E3S Web Conferences, 451*, 06011. doi:https://doi.org/10.1051/e3sconf/202345106011

Alexiou, A., & Schippers, M. C. (2018). Digital game elements, user experience and learning: A conceptual framework. *Education and Information Technologies, 23*, 2545-2567.

Alyahya, D. M., & Alotaibi, A. (2019). Computational thinking skills and its impact on TIMSS achievement: An Instructional Design Approach. *Issues and Trends in Educational Technology, 7*(1), 3-19. doi:http://dx.doi.org/10.2458/azu_itet_v7i1_alyahya

Arnab, S., Berta, R., Earp, J., de Freitas, S., Popescu, M., Romero, M., & Usart, M. (2012). Framing the adoption of serious games in formal education. *Electronic Journal of e-learning, 10*(2), 159-171.

Bandura, A. (1997). *The Exercise of Control is a psychology.* New York: W.H. Freeman and Company.

Online ISSN 2655-2450 | Print ISSN 2655-2388

Barab, S. A., Gresalfi, M., & Ingram-Goble, A. (2011). Transformational Play: Using Games to Position Person, Content, and Context. *Educational Researcher, 39*(7), 525-536. doi:10.3102/0013189X10386593

Bimba, A. T., Idris, N., Al-Hunaiyyan, A., Ibrahim, S. U., Mustafa, N., Supa'at, I., . . . Ahmad, M. Y. (2021). The Effects of Adaptive Feedback on Student's Learning Gains. *International Journal of Advanced Computer Science and Applications,, 12*(7), 68-80.

Bloom, B. (1984). The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring. *Educational Researcher, 13*, 4-16. doi:http://dx.doi.org/10.3102/0013189X013006004

Bolliger, D. U., & Martin, F. (2018). Instructor and student perceptions of online student engagement strategies. *Distance Education, 39*(4), 568-583. doi:http://dx.doi.org/10.1080/01587919.2018.1520041

Brinson, J. R., & Thomas, C. M. (2020). Learning in digital game-based environments: A meta-analytic review. *Journal of Educational Computing Research, 58*(1), 35-58.

Candrawati, E., Uliyandari, M., Rustaman, N. Y., & Kaniawati, I. (2022, May). Profile of Computational Thinking Skills in Environmental Chemistry Courses for Prospective Science Teacher Students. *Jurnal Penelitian Pendidikan Sains, 11*(2), 152-165.

Chau, B., Nash, R., Sung, K., & Pace, J. (2015). Building Casual Games and APIs for Teaching Introductory Programming Concepts Game-Themed Instructional Modules: A Video Case Study. *FDG 2015: Proceedings of the Tenth International Conference on the Foundations of Digital Games.*

Cheng, Y.-P., Lai, C.-F., Chen, Y.-T., Wang, W.-S., Huang, Y.-M., & Wu, T.-T. (2023). Enhancing student's computational thinking skills with student-generated questions strategy in a game-based learning platform. *Computers & Education, 200*, 104794. doi:https://doi.org/10.1016/j.compedu.2023.104794

Cheung, A., & Slavin, R. (2013). The effectiveness of educational technology applications on mathematics achievement in K-12 classrooms: A meta-analysis. *Educational Research Review, 9*, 88-113. doi:https://doi.org/10.1016/j.edurev.2013.01.001

Ch'ng, S. I., Low, Y. C., Lee, Y. L., Chia, W. C., & Yeong, L. S. (2019). Video Games: A Potential Vehicle for Teaching Computational Thinking. In S. C. Kong, & H. Abelson, *Computational Thinking* (pp. 247-260). Singapore: Springer Nature Singapore.

Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education,* 59(2), 661-686. doi:10.1016/j.compedu.2012.03.004

Diniz, G. C., Silva, M., Gerosa, M., & Steinmacher, I. (2017). Using gamification to orient and motivate stu-dents to contribute to OSS project. *IEEE/ACM 10th* (pp. 36-42). New York: IEEE.

Dominguez, A., Saenz-de-Navarrete, J., de-Marcos, L., Fernandez-Sanz, L., Pages, C., & Martinez-Herraiz, J. J. (2013). Gamifying learning experiences: Practical implications and outcomes. *Computers & Education,* 63, 380-392.

Francis, T. T., Ezenkiri, J. N., & Enock, G. (2022). Assessment of Teachers' Knowledge and Use of Mastery Learning Strategy in the Implementation of Basic School Creative Arts Curriculum in Katsina State, Nigeria. *KIU Journal of Education,* 2(1), 54-60.

Gee, J. P. (2003). What video games have to teach us about learning and literacy. *Computers in Entertainment*.

González, L., Jiménez, F., & Moreira, M. (2018). Más allá del libro de texto. La gamificación mediada con TIC como alternativa de innovación en Educación Física. *Retos: nuevas tendencias en educación física, deporte y recreación, 34*, 343-348.

Grover, S., & Pea, R. (2013). Computational thinking in K-12: A review of the state of the field. *Educational Researcher, 42*(1), 38-43.

Guzsvinecz , T., & Szelinger, A. (2024). Analyzing the Bibliometric Trends in Gamification Research Using the Bibliometrix R-Tool. In T. Guzsvinecz, *Level Up! Exploring Gamification's Impact on Research and Innovation* (pp. 2-22). Hungary: IntechOpen. doi:10.5772/intechopen.1001659

Hamari, J., Shernoff, D. J., Rowe, E., Coller, B., Clarke, J. A., & Edwars, T. (2016). Challenging games help students learn: An Empirical study engagement, floe,

Online ISSN 2655-2450 | Print ISSN 2655-2388

and immersion in game-based learning. *Computers in Human Behavior, 54*, 170-179.

Heintz, F., Mannila, L., & Färnqvist, T. (2016). A review of models for introducingcomputational thinking, computer science and computing in K-12 education. *2016 IEEE Frontiers in education conference (FIE)* (pp. 1-9). USA: IEEE Press. doi:https://doi.org/10.1109/FIE.2016.7757410

Hidayat, R., Patras, Y. E., Usman, H., Gunawan, Y., & Windiyani, T. (2023). Bibliometric Analysis of Ethical Behavior in Education Using VOSviewer. *Journal of Innovation in Educational and Cultural Research, 4*(1), 157-166.

Hossain, N., Dayarathna, V., Nagahi, M., & Jaradat, R. (2020). Systems thinking: A review and bibliometric analysis. *Systems, 8*(3), 1-26. doi:https://doi.org/10.3390/systems8030023

Hunsaker, E. (2020). *Computational Thinking. The K-12 Educational Technology Handbook.* Retrieved June 26, 2024, from https://edtechbooks.org/k12handbook/computational_thinking

Hussein, M. H., Ow, S. H., Cheong, L. S., & Thong, M. K. (2019). A digital game-based learning method to improve student's critical thinking skills in elementary science. *IEEE Access, 7*, 96309–96318. doi:https://doi.org/10.1109/ACCESS.2019.2929089

Jenkins, H. (2007). Confronting the Challenges of Participatory Culture – Media Education for the 21st Century. *Nordic Journal of Digital Literacy, 2*(2), 97-113. doi:https://doi.org/10.18261/ISSN1891-943X-2007-02-04

Ji, W., Yu, S., Shen, Z., Wang, M., Cheng, G., Yang, T., & Yuan, Q. (2023). Knowledge Mapping with CiteSpace, VOSviewer, and SciMAT on Intelligent Connected Vehicles: Road Safety Issue. *Sustainability, 15*(15), 2-32. doi:https://doi.org/10.3390/su151512003

Jiang, X., Harteveld, C., Huang, X., & Fung, A. Y. (2019). The computational puzzle design framework: a design guide for games teaching computational thinking. *In The Fourteenth International Conference on the Foundations of Digital Games (FDG '19)* (pp. 1-11). San Luis Obispo: ACM. doi:https://doi.org/10.1145/3337722.3337768

Jossan, K. S., Gauthier, A., & Jenkinson, J. (2021). Cultural implications in the acceptability of game-based learning. *Computers & Education, 174*(2), 104305. doi:http://dx.doi.org/10.1016/j.compedu.2021.104305

Ke, F. (2016). Designing and integrating purposeful learning in game play: A systematic review. *Educational Technology Research and Development, 64*(2), 219-244. doi:https://doi.org/10.1007/s11423-015-9418-1

Kiili, K., de Freitas, S., Arnab, S., & Lainema, T. (2022). Collaborative game-based learning: Investigating the impact on learners' outcomes. *British Journal of Educational Technology, 53*(3), 575-591.

Kirriemuir, J., & McFarlane, A. (2004). *Literature review in games and learning.* Futurelab Series.

Kraska, T. (2020). Establishing a connection for students between the reacting system and particle model with games and stochastic simulations of the Arrhenius equation. *Journal of Chemical Education, 97*(7), 1951-1959.

Lee, J., & Hammer, J. (2011). Gamification in Education: What, How, Why Bother? *Academic Exchange Quarterly, 15*(2), 1-5.

Li, Y., Chen, D., & Deng, X. (2024). The impact of digital educational games on student's motivation for learning: The mediating effect of learning engagement and the moderating effect of the digital environment. *PLoS ONE , 19*(1), e0294350. doi:https://doi.org/10.1371/journal.pone.0294350

Lin, C. H., Liu, E. Z., Chen , Y. L., Liou, P. Y., Chang, M., & Wu, C. H. (2013). Game-Based Remedial Instrucion in Mastery Learning for Upper-Primary School Students. *Educational Technology & Society, 16*(2), 271-281.

Lopez, M. A., Duarte, E. V., Gutierrez, E. C., & Valderrama, A. P. (2016). Teaching abstraction , function and reuse in the first class of CS1: A lightbot experience. *the 2016 ACM Conference on Innovation and Technology in Computer Science Education (ITiCSE '16).* (pp. 256-257). New York: ACM Digital Library. doi:https://doi.org/10.1145/2899415.2925505

Malik, S., Prabawa, H. W., & Rusnayati, H. (2017). *Peningkatan Kemampuan Berpikir Komputasi Siswa Melalui Multimedia Interaktif Berbasis model Quantum Teaching and Learning.* Bandung: Universitas Pendidikan Indonesia.

Online ISSN 2655-2450 | Print ISSN 2655-2388

Mayer, R. E. (2024). The Past, Present, and Future of the Cognitive Theory of Multimedia Learning. *Educational Psychology Review, 36*(8), 2-25. doi:https://doi.org/10.1007/s10648-023-09842-1

Minović, M., & Milovanović, M. (2013). Real-time learning analytics in educational games. *The First International Conference on Technological Ecosystem for Enhancing Multiculturality* (pp. 245-251). New York: Association for Computing Machinery. doi:http://dx.doi.org/10.1145/2536536.2536574

Mukhtar. (2020). Implementasi Mastery Learning Untuk Pencapaian Standar Kompetensi Siswa dalam Pembelajaran Pendidikan Agama Islam di SMA Negeri 2 Bogor. *Fenomena, 19*(2), 214-247.

Ng, B. (2018). The Neuroscience of Growth Mindset and Intrinsic Motivation. *Brain Sciences, 8*(2), 20. doi:http://dx.doi.org/10.3390/brainsci8020020

O'Rourke, E., Haimovitz, K., Ballweber, C., Dweck, C., & Popović, Z. (2014). Brain points: A growth mindset incentive structure boosts persistence in an educational game. *Proceedings of the 32nd Annual ACM Conference on Human Factors in Computing Systems* (pp. 3339–3348). Canada: ACM.

Peery, J. G., & Pasalar, C. (2018). Designing the Learning Experiences in Serious Games: The Overt and the Subtle—The Virtual Clinic Learning Environment. *Informatics, 5*(3), 30. doi:http://dx.doi.org/10.3390/informatics5030030

Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of Game-Based Learning. *Educational Psychologist, 50*(4), 258-283.

Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of Game-Based Learning. *Educational Psychologist, 50*(4), 258-283.

Prahani, B. K., Nisa, K., Jatmiko, B., Suprapto, N., Amelia, T., & Candrawati, E. (2022). THe Comparison of the Top 100 Cited Publications of Augmented Reality and Virtual Reality for the Last Thirty Years. *International Journal of Online and Biomedical Engineering, 18*(6), 13-27.

Putri, V., Syahmani, & Prasetyo, Y. D. (2023). Bibliometric Study of Articles on Computational Thinking in Learning. *Journal of Mathematics, Science, and Computer Education, 3*(1), 1-11.

Ria, R. R. (2024). Computational Thinking Assessment: Bibliometric Analysis-VOSviewer. *Jurnal Simki Pedagogia, 7*(1), 305-316.

Riva, I. (2012). *Koleksi Games Edukatif di Dalam dan Luar Sekolah.* Yogyakarta: FlashBooks.

Saavedra, A. R., & Opfer, V. D. (2012). Teaching 21st-century skills: What does it look like in practice? *Journal of Educational Research, 14*(3), 8-16.

Sabourin, J. L., Shores, L. R., Mott, B. W., & Lester, J. C. (2013). Understanding and predicting students self-regulated learning strategies in game-based learning environments. *International Journal of Artificial Intelligence in Education, 23*(1), 94-114.

Setyaningsih, I., Indarti, N., & Jie, F. (2018). Bibliometric analysis on the term "green manufacturing". *International Journal of Management Concepts and Philosophy, 11*(3), 315.

Shen, Z., Ji, W., Yu, S., Cheng, G., Yuan, Q., Han, Z., . . . Yang, T. (2023). Mapping the Knowledge of Traffic Collision Reconstruction: A Scientometric Analysis in CiteSpace, VOSviewer, and SciMAT. *Science & Justice,* 63(1), 19-37. doi:https://doi.org/10.1016/j.scijus.2022.10.005

Shute, V. J., Ventura, M., & Ke, F. (2017). The power of play: The effects of portal 2 and lumosity on coqnitive and noncognitive skills. *Computers & Education, 80*, 58-67.

Silva, F. G. (2020). Practical Methodology for the Design of Educational Serious Games. *Information, 11*(14), 1-13.

Silvana, J. (2021). Pengembangan Game " Script Labyrinth" Untuk Meningkatkan Computational Thinking Siswa Dalam Pelajaran Pemrograman Web dan Perangkat Bergerak di SMKN 2 Surabaya. *Jurnal IT-EDU, 5*(2), 667-676.

Stéphanie, D. R., Hallifax, S., Serna, A., Marty, J.-C., Stephane, S., & Lavoué, E. (2022). The Impact of Game Elements on Learner Motivation: Influence of Initial Motivation and Player Profile. *IEEE Transactions on Learning Technologies, 15*(1), 1-15. doi:10.1109/TLT.2022.3153239

Sukirman, Ibrahim, L. F., Said, C. S., & Murtiyasa, B. (2022). A Strategy of Learning Computational Thinking through Game Based in Virtual Reality: Systematic Review and Conceptual Framework. *Informatics in Education, 21*(1), 179-200.

Troiano, G. M., Snodgrass, S., Argimak, E., Robles, G., Smith, G., & Cassidy, M. (2019). Is My Game OK Dr. Stratch? Exploring Programming and Computational

Online ISSN 2655-2450 | Print ISSN 2655-2388

Thinking Development via Metrics in Student-Designed Serious Game for STEM. *The 18th ACM International Conference on Interaction Design and Children* (pp. 208-219). New York: Association for Computing Machinery.

Tupan, T., Rahayu, R. N., Rachmawati, R., & Rahayu, E. (2018). Analisis Bibliometrik Perkembangan Penelitian Bidang Ilmu Instrumentasi. *Jurnal Dokumentasi dan Informasi, 39*(2), 135-149.

Turchi, T., Daniela, F., & Malizia, A. (2019). Fostering Computational Thinking Through Collaborative Game-Based Learning. *Multimedia Tools and Applications, 78*.

Udeozor, C., Chan, P., Abegão, F. R., & Glassey, J. (2023). Game-based assessment framework for virtual reality, augmented reality and game-based learning. *International Journal of Educational Technology in Higher Education, 20*(36), 1-22. doi:https://doi.org/10.1186/s41239-023-00405-6

Vahldick , A. (2020). A Blocks-based Serious Game to Support Introductory Programming in Undergraduate Education. *Computers in Human Behavior Reports*, 1-12.

Wing, J. M. (2006). Computational Thinking. *Communications of the ACM, 49*(3), 33-35. doi:https://doi.org/10.1145/1118178.1118215

Winget, M., & Persky, A. M. (2022). A Practical Review of Mastery Learning. *American Journal of Pharmaceutical Education, 86*(10), 8906. doi:10.5688/ajpe8906

Wouters, P., van Nimwegen, C., van Oostendorp, H., & van der Spek, E. D. (2013). A meta-analysis of the cognitive and motivational effects of serious games. *Journal of Educational Psychology, 105*(2), 249-265. doi:https://doi.org/10.1037/a0031311

Young, M. F., Slota, S., Cutter, A. B., Jallete, G., Mullin, G., Lai, B., & Yukhymenko, M. (2012). Our princess in another castle: A review of trends in serious gaming for education. *Review of Educational Research, 82*(1), 61-89.