

Game-Based Cooperative Learning and its Implications for Improving Learning Motivation

Dr. Sanjiv Kumar Jain ^{1*}, Dr.S.Hemajothi ²

¹ Medi-Caps University, Indore, India.

² Vel Tech High Tech Dr.Rangarajan Dr.Sakunthala Engineering College, India.

*Corresponding Author Email: ¹ sanjivkj@gmail.com

Abstract

In this research game-based learning scope is highlighted where the market growth of digital learning is discussed as a foundation of this study. Emergence of game-based learning throughout the globe is considered as a major purpose of this study to get better insight on the relevant factors of the subject. Through this research students' motivation and its relevance with game-based learning is aimed to be identified along with suitable objectives. Explanatory research design, qualitative strategy and interpretivism philosophy is selected for this research. Secondary sources are used for data collection where journals and articles are used for data collection. The impact of game-based learning (GBL) on the motivation level of the student has been explained in a proper manner. The connection between skill development and GBL has also been illustrated along with its impact on the retention rate. The true notion of gamification which lies in providing a positive experience for the students has also been explained in a brief manner. GBL's fundamental core has been identified as being related with a number of aspects such as experiential learning theory, gaming technology, digital connection, and others. The truth has surfaced regarding the influence of GBL being driven by a robust virtual learning environment and ultimately changing the dynamics of both education and learning.

Keywords

Augmented reality, Commercial off-the-shelf (COTS), game-based learning, Information and communication technology (ICT), Learning management system (LMS), motivation, Non-cognitive skills, Research design, retention, Student motivation.

INTRODUCTION

Research background

Digital learning environment in educational platforms is becoming a popular method of teaching students with maximum effectiveness. Game-based learning approaches are being taken by many institutions throughout the world to adopt a unique way of teaching the students. Game-based learning strategies are highly effective in developing skills within students by linking the virtual learning environment with a real world setting. Game-based learning engages the students to participate in specific activities which provide learning opportunities to the students with enjoyment [1]. Game-based learning practices are being integrated in diverse educational sectors and the market of digital education is gradually increasing. In diverse industry contexts, game-based learning is highly relatable because giant global retail companies are incorporating game-based learning systems in their training using augmented reality technology.

Hence, the emergence of game-based learning is indicating a significant market scope for businesses and educational institutions. The game-based learning market in the world is estimated to be valued at US \$ 10.90 billion which can reach US \$62.09 million in 2022 [2]. Game-based learning utilizes the latest technologies which make learning purposes more effective and students can generate a positive perspective about learning specific subjects. Emerging adoption of Game-based learning throughout the globe is indicating a strong market position of the industry in future. Hence, this research can focus on the core factors of Game-based

learning and its relevance with student learning motivation. Insights on the game-based learning environment can enhance the understanding of future settings of learning that can make people aware about the importance of digital learning experience.

Aim and Objectives

This research aims to identify the relation between game-based learning and student motivation within a learning setting to determine the significance of digital learning. Certain objectives are recognized months research to reach the aim:

- To investigate the impact of game-based learning on skill and motivation development
- To determine the effectiveness of game-based learning in retaining students
- To understand the significance of game-based learning in cognitive intelligence and cooperation development

Purpose of the research

The major purpose of research is to fulfill its aim of establishing a critical analysis on the game-based learning and its relativity with the students' motivation. In order to conduct a critical analysis this research focuses on the key aspects of game-based learning in the modern learning environment to represent a thorough understanding of the future educational settings. People' expectations from education are changing with emerging digital technology [3]. This research penetrates into the learning settings where student engagement, performance, teaching methods and

technological aspects are aimed to be investigated. Different key issues related to game-based learning can be identified with this research to improve the digital learning infrastructure in future.

METHODS AND MATERIALS

Research design

Depending on a specific structure a researcher conducts studies to fulfill its aims by meeting its objectives effectively. Research design is a major component of research studies because it provides a clear understanding of the process of the data collection and further analysis. Descriptive, experimental, Correlational, diagnostic and exploratory research designs are commonly used by researchers to conduct their studies. Descriptive design focuses on the research questions to find the underlying causes of occurrences. Experimental design identifies the causes and impacts of the occurrences within a dataset. Correlational design establishes the relationships of variables to make suitable assumptions [4]. Diagnostic design investigates the phenomenon within a dataset to evaluate its underlying causes. Explanatory research design focuses on theoretical explanations of occurrences to answer the research questions accurately. Considering the objectives of the study, experimental research design can justify the research aims. *Explanatory research design* can provide theoretical analysis on the phenomenon identified within the dataset.

Research type

Research type or strategy is the foundation of all methods and techniques as based on research type a researcher structures the stages of a research paper. Research studies are commonly performed in two manners: quantitative and qualitative. Quantitative research is useful for statistical analysis of the findings from a dataset [5]. On the other hand, qualitative research focuses on theoretical and generalization of the findings to answer the research questions. In this research qualitative strategy is selected to justify the discussion at the end of the research paper. Detailed discussion about the phenomenon can be done with qualitative strategy as it focuses on the theories and relative studies to identify relative factors. Qualitative research is extremely suitable for this study as it supports the interpretivism philosophy of the researcher to obtain a large amount of information from different sources.

Research philosophy

In research studies, the significance of a researcher's mindset and perception about specific factors is extremely evident in the quality of the final paper. Research philosophy is the belief of the researcher that influences the data collection process and further evaluation of the findings. Research philosophy is the driver of uniqueness within research settings that provide diverse views on a single subject. Positivism philosophy believes in a single truth whereas interpretivism believes in different realities [6]. In

research, interpretivism can contribute to generating high quality and reliable assumptions from the dataset. Interpretivism can theoretically explain the findings by observing the occurrences within a dataset with different perspectives. Interpretivism philosophy of the researcher can give a broader insight on existing facts regarding the subject. Interpretivism philosophy investigates multiple realities that underpin critical analysis on the findings.

Inclusion/exclusion criteria

The researchers assumed the reliability of the study by integrating certain criteria for data collection.

Inclusion criteria:

- Authentic documents with proper date, author name and page number will be obtained for this research
- All the data sources must be taken from the publication within last 5 years to maintain the relevance of the information

Exclusion criteria:

- Unreliable data sources such as random websites and personal blogs will not be taken for data collection
- Sources that includes any language other than English will not be taken

Data collection

Data Collection for this research is decided on the aforementioned methods and strategies. Data is commonly collected from two sources which are: primary and secondary. Primary data is collected under the supervision of the researcher on the variables of the research questions [7]. Primary sources collect data from the real environment using surveys and secondary sources collect data from existing documents such as journals, articles and government reports. Considering the research type, inclusion of secondary sources for data collection can be beneficial for the researcher to generate a critical analysis using existing documents. Secondary qualitative data is collected from Google scholar and authentic websites such as government and organization websites. Observation of the researcher can produce a diverse set of facts and knowledge which are relevant to the subject area.

RESULTS

Game-based learning promotes student motivations and skill development

In the modern learning business it is clearly visible that digital learning practices are increasing gradually worldwide. Existing research information indicates that the global game-based learning market is growing rapidly and it can grow at US \$29.7 billion by 2026 [8]. Hence, it can be assumed that game-based learning is becoming a popular method of teaching in different platforms throughout the world. It also highlights that incorporating game-based learning is providing effective results in students' learning.

game-based learning collaborative learners in a way where their participation is driven by utmost engagement.

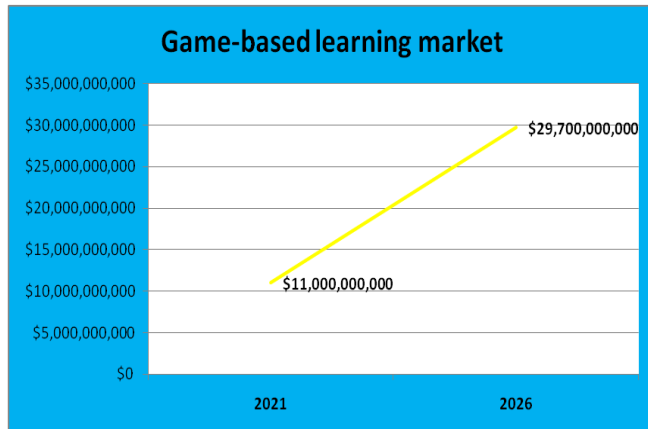


Figure 1: Game-based learning market growth (Source: Self-developed)

Students get motivated in the learning process as they are assisted by their peers in the activities which are attractive and entertaining at the same time. Gamification provides a better scope for engaging the students in learning activities from an early age as children are interested in the games and its relevant tools while learning [9]. Teachers can integrate games in daily teaching practices to bring the attention of the students and within a limited time the teacher can focus on a large number of students. Educational needs of the students can be identified through a game-based learning environment and it brings better earning opportunities for the students.

Gamification the learning process encourages the students to socialize with others more effectively which builds a cooperative environment that helps them to stay focused on the learning process. Team based activities motivate the students to engage in unique learning settings with their peers and collectively a teacher can motivate a large number of students [10]. Non-cognitive skills such as patience, motivation and cooperative mentality among the students improve through game based learning. Motivated students can take advantage of the game-based learning practices to improve their social and educational skills at the same time.

Game-based learning (GBL) can be considered an effective method which can increase the engagement level of the student to a certain extent. These types of techniques are also perceived as an addition to the conventional pedagogies which are liable for encouraging students to participate in a learning process [11]. This type of learning technique often focuses on several combinations of game features and effective strategies that can create a positive impact on the engagement level of the student. Motivation can be considered a crucial part of each learning program which is essential for gaining positive results in the end. Lack of adequate motivation among the students during the learning programs can hinder the overall outcome which can be reflected in a degraded academic score. These approaches can also generate a sense of competition among the learners

which can provide continuous motivation with the usage of game points, leaderboards, levels and others.

The rise of modification in modern learning techniques has been supported by the adaptation of GBL which has received adequate attention from learning institutes. Several learning institutions have been known for using GBL as their daily driver for encouraging students of higher education which showed positive results in terms of student engagement along with improving the perception of the relevant stakeholders [12]. Association with the GBL is also known to create a sense of control among the students that can foster the necessary capabilities and skill sets which are required to deal with several challenges in a game.

Students retention increases with gamification in education platforms:

The rise of technology can be perceived as a beneficial aspect which can be implemented in the learning process to encourage student participation. Collaboration among modern equipment such as computers, mobile phones and similar audio-visual learning techniques with the existing university learning methods can attract the attention of the learners. The concept of gamification can be utilized in circumstances such as this which can provide scope for implementing procedures or mechanisms that can incorporate the game in a non-gaming process [13]. Due to its higher prevalence and positive results, the number of including gamification processes in learning programs has risen significantly over the past few years. The overall aspect of gamification can also be perceived as a tool for evaluating the performance level of users along with increasing the retention rate which is important for the overall success of a learning program.

It is not uncommon for students to face difficulties in maintaining adequate amounts of focus due to the higher stress level in academic courses. Learning institutions are known for offering several types of rewards and punishments to maintain the proper flow of student retention as per their performance level. Gamification of the learning process can be considered an effective method of reward which can increase the student retention level to a significant amount. It provides a significant amount of achievement and challenges that can cater for the needs of competency among the students [14]. It helps learners to build an emotional attachment to the learning process which can offer different types of experiences to maintain their interest level. Proper use of guidance, metrics and other supportive aspects are often offered by learning institutes which can act as essential drivers for motivation.

Projects can be recognised as a significant driver within the transition towards the idea of sustainability. On the other hand, *sustainability thinking* plays a pivotal role in terms of influencing the standards of project management. It eventually carves the foundation driven by the impacts of gamification in terms of improving the metrics of the innovative learning process. Fundamentally the core of GBL

has been recognised to be associated with several factors such as *experiential learning theory, gaming technologies, digital connectivity*, and others. The fact has emerged addressing the impact of GBL being driven by a robust platform of virtual learning environment and eventually improving the dynamics of both education and learning [15]. As its foundation aligns with the fundamental idea of student engagement, virtual learning plays a pivotal role in terms of improving the metrics of the immersive learning environment. It eventually enhances the standards of student retention as it follows the path of motivating educators.

Cooperation and cognitive intelligence improves with game-based learning

Game-based learning processes are designed in such a manner in creating enormous opportunities for the educators to cope with the complexity of a specific teaching environment. It aligns with the fact suggesting the correlation of GBL and the enhancement of several channels of interactions, especially for the students. It carves the foundation for GBL to be driven by factors such as *concrete and active experimentation, abstract conceptualisation, feedback foster learning* [16]. On the other hand, the fact has emerged in such a manner addressing the effectiveness of GBL to ensure the succession of an entire learning process within its elementary counterpart. Elementary level has been recognised to be associated with the foundation of the entire education context [17]. GBL comes into this picture as an effective approach to deal with the enhancement of various factors associated with this particular foundation. Gamification of education is strongly correlated with the implementation of several practical methods. It eventually carves the alliance between GBL and cognitive intelligence as it is entirely driven by it.

Gamification is traditionally enumerated as the implementation of *“game-design elements”* within the *“non-game contexts”*. This particular aspect has been recognised to be associated with the development of *game thinking* and *game mechanics* in solving different kinds of problems. Structurally, gamification holds the lion’s-share in terms of improving the standards of cognitive intelligence as it aligns with the process of co-creating enhanced learning experiences [18]. The enhancement of cognitive intelligence thus follows the footsteps of gamification due to the integration of various elements such as *points, complex and easy levels*, and others. As different technologies are integrated within the virtual learning process, it changes the premises of GBL. The metrics of student engagement are changed dramatically as various essential elements impose a centralised control over its core such as *content, innovative interaction mechanism*, and others. GBL emerges as an effective channel of teaching as it leads to the path of several advantages including *developing student skills and knowledge, improving student motivation, enhancing problem-solving ability and imagination*, and others.

Information and communication technology (ICT) plays

an effective role in terms of enhancing the standards of various factors related to societal context. Education, in this instance, is arguably the most important aspect associated with this particular context. Globalisation, on the other hand, holds the lion’s-share contribution in terms of changing the traditional point-of-view of several factors ranging from business to education. The enormous growth of ICT accelerates in this instance in terms of improving the foundation of both resource-driven and knowledge-based learning processes. It eventually carves the collaboration of ICT and technology-enhanced learning (TEL) as an integral element associated with the enhancement of its classical counterpart. The fact has emerged addressing the tremendous influence of ICT as it undergoes *dynamic interactive and engaging content* [19]. Cognitive intelligence thus gets enhanced through the lens of ICT integration as it enables meaningful information to be *individually* and *effectively* catered.

DISCUSSION

Digital game-based learning (DGBL) can be viewed as a strong foundation of effective learning approaches in terms of enhancing the metrics of teaching quality. This particular aspect has been recognised to be associated with the enhancement of various factors linked to the traditional foundation. The fundamental idea of this particular approach is mainly associated with the integration of several activities such as *problem-solving, analytical*, and others [20]. On the other hand, GBL plays a pivotal role in terms of enhancing the foundation of problem-solving skills within the elementary education levels. In this instance the fact has emerged in such a manner addressing the significance of GBL in improving the standards of this particular association of activities. GBL can also be described as a particular educational approach driven by the standards of innovation. It eventually links to its core theme to maintain the normalcy of the entire teaching process.

Globalisation has simply ruptured the classical perspectives of the education sector in the global landscape. It links to the dramatic transition of the global business triggered by its emergence. Globalisation has not only changed the standards of global business, it also changes the standards of the global landscape of education. The Covid 19 delivers the role of the catalyst in this instance to change the construct associated with its classical counterpart. Game-based teaching comes into this picture in terms of playing a pivotal role in changing the entire teaching process [21]. As ICT is placed at the core of it, the channels of effective communication and interaction get eventually improved. Mobile technologies have emerged as one of the most feasible options in this manner holding the significant control to improve the existing metrics. As engagement emerges as the most essential element in this digital ecosystem, GBL arguably becomes the most essential tool for its enhancement.

Over the years games are the most essential element placed at the epicentre of the learning process. More particularly it has always been an integral element of the foundation of the learning process. On the other hand, its alliance with the foundation of cognitive skills leads the path to become an essential element in this manner. This particular collaboration of game and non-game context carves the foundation of imposing a centralised control over both learning and teaching process. GBL is mainly designed in such a manner as it maintains the balance between *subject matter* and *gameplay* [22]. It carves the foundation for GBL to initiate the foundation of assessing the learner's ability to retain followed by the standards of the implementation of acquired knowledge to real-world scenarios.

Learning environment plays a pivotal role as an integral element is a certain teaching scenario. More precisely it is responsible for improving several constructs associated in this regard. Structurally, GBL spans from games developed to cope with both *learning* and *instructional* objectives [23]. It eventually enables different channels for a particular student in terms of exploring a certain subject matter along with the usage of *commercial off-the-shelf (COTS)* digital games. Gamification, thus considers the most essential element as an integral element of the learning-management system (LMS) driven by the parameters of GBL [24]. *Narratives* in this instance, emerges as an essential tool of GBL to improve the standards of *motivation, engagement, and learning*.

CONCLUSION

The current study's thematic canvas is to examine the significance of Game Based Learning (GBL). The fact has emerged in such a way that it suggests the enormous effect of GBL in terms of enhancing motivation metrics within the learner segment. In this case, the current study has demonstrated the significance of incorporating an innovative teaching technique into the basis of teaching. Learners are at the core of this particular environment, GBL makes the lion's share of contributions to enhancing the standards of student participation within this system. The current study has shown the importance of GBL in this respect. As student engagement is the most essential measure to intercept the effectiveness of the entire learning process, the present study has addressed the significance of using innovative and advanced methods to maintain the normalcy of attracting students in this regard.

Learning management system is one of the most essential elements associated with the foundation of the teaching process. More precisely it is responsible for controlling various parameters associated with the entire teaching process. The present study has analysed the importance of ICT in term of improving the foundation of this particular system. GBL has a strong correlation with the robust nature of LMS and the present study has extracted this scenario as the enhancement of overall learning experiences. Students are driven to study when they are aided by their classmates in

activities that are both appealing and engaging. Gamification allows for more opportunities to engage students in learning activities from an early age since youngsters are interested in games and their associated tools while learning. The present study also describes gamification as one of the learning processes that can be regarded as an effective technique of reward that can significantly boost student retention. It also highlights its effectiveness to extract the substantial quantity of success and difficulties that can meet the kids' competence demands.

REFERENCES

- [1] Hartt, M., Hosseini, H., & Mostafapour, M. (2020). Game on: Exploring the effectiveness of game-based learning. *Planning Practice & Research*, 35(5), 589-604. <https://www.tandfonline.com/doi/pdf/10.1080/02697459.2020.1778859>
- [2] Prnewswire.co.uk, (2022). *Game-Based Learning Market size worth \$ 62.09 Billion, Globally, by 2030 at 21.33% CAGR: Verified Market Research*. Retrieved on: 5th January, 2022. From: <https://www.prnewswire.co.uk/news-releases/game-based-learning-market-size-worth-62-09-billion-globally-by-2030-at-21-33-cagr-verified-market-research-r--809918303.html>
- [3] Klingenberg, O. G., Holkesvik, A. H., & Augestad, L. B. (2020). Digital learning in mathematics for students with severe visual impairment: A systematic review. *British Journal of Visual Impairment*, 38(1), 38-57. <https://journals.sagepub.com/doi/pdf/10.1177/0264619619876975>
- [4] Schober, P., Boer, C., & Schwarte, L. A. (2018). Correlation coefficients: appropriate use and interpretation. *Anesthesia & Analgesia*, 126(5), 1763-1768. https://journals.lww.com/anesthesia-analgesia/Fulltext/2018/05000/Correlation_Coefficients___Appropriate_Use_and.50.aspx
- [5] Moser, A., & Korstjens, I. (2018). Series: Practical guidance to qualitative research. Part 3: Sampling, data collection and analysis. *European journal of general practice*, 24(1), 9-18. <https://www.tandfonline.com/doi/pdf/10.1080/13814788.2017.1375091>
- [6] Alharahsheh, H. H., & Pius, A. (2020). A review of key paradigms: Positivism VS interpretivism. *Global Academic Journal of Humanities and Social Sciences*, 2(3), 39-43. https://gajrc.com/media/articles/GAJHSS_23_39-43_VMGJbOK.pdf
- [7] HR, G., & Aithal, P. S. (2022). How to Choose an Appropriate Research Data Collection Method and Method Choice among Various Research Data Collection Methods and Method Choices During Ph. D. Program in India?. *International Journal of Management, Technology, and Social Sciences (IJMITS)*, 7(2), 455-489. https://www.researchgate.net/profile/Ganesha-H-R/publication/365096704_How_to_Choose_an_Appropriate_Research_Data_Collection_Method_and_Method_Choice_Among_Various_Research_Data_Collection_Methods_and_Method_Choices_During_PhD_Program_in_India/links/6364b15637878b3e877e5c19/How-to-Choose-an-Appropriate-Research-Data-Collection-Method-and-Method-Choice-Among-Various-Research-Data-Collection-Methods-and-Method-Choices-During-

- PhD-Program-in-India.pdf
- [8] Globenewswire.com, (2022). *21.9% CAGR - The Game-Based Learning Market Size is Predicted to Reach US\$29.7 billion by 2026 Globally says MarketsandMarkets*. Retrieved on: 5th January, 2022. From: <https://www.globenewswire.com/en/news-release/2022/11/08/2551002/0/en/21-9-CAGR-The-Game-Based-Learning-Market-Size-is-Predicted-to-Rreach-US-29-7-billion-by-2026-Globally-says-MarketsandMarkets.html>
- [9] Manzano-León, A., Camacho-Lazarraga, P., Guerrero, M. A., Guerrero-Puerta, L., Aguilar-Parra, J. M., Trigueros, R., & Alias, A. (2021). Between level up and game over: A systematic literature review of gamification in education. *Sustainability*, 13(4), 2247. <https://www.mdpi.com/2071-1050/13/4/2247/pdf>
- [10] Naseem, M. Y. (2021). THE SCOPE OF GAMIFICATION IN PEDAGOGICAL CONTEXTS: AN OVERVIEW OF LITERATURE. *EPR International Journal of Multidisciplinary Research (IJMR)*, 7(4), 1-1.
- [11] Dabbous, M., Kawtharani, A., Fahs, I., Hallal, Z., Shouman, D., Akel, M., ...&Sakr, F. (2022). The Role of Game-Based Learning in Experiential Education: Tool Validation, Motivation Assessment, and Outcomes Evaluation among a Sample of Pharmacy Students. *Education Sciences*, 12(7), 434. <https://www.mdpi.com/2227-7102/12/7/434/pdf>
- [12] Zou, D., Zhang, R., Xie, H. and Wang, F.L., 2021. Digital game-based learning of information literacy: Effects of gameplay modes on university students' learning performance, motivation, self-efficacy and flow experiences. *Australasian Journal of Educational Technology*, 37(2), pp.152-170. <https://ajet.org.au/index.php/AJET/article/download/6682/1754/>
- [13] Saleem, A. N., Noori, N. M., &Ozdamli, F. (2022). Gamification applications in E-learning: A literature review. *Technology, Knowledge and Learning*, 27(1), 139-159. <https://doi.org/10.1007/s10758-020-09487-x>
- [14] Saputro, R. E., Salam, S., Zakaria, M. H., & Anwar, T. (2019). A gamification framework to enhance students' intrinsic motivation on MOOC. *TELKOMNIKA (Telecommunication Computing Electronics and Control)*, 17(1), 170-178. <http://telkomnika.uad.ac.id/index.php/TELKOMNIKA/article/viewFile/10090/6061>
- [15] Foster, A., & Shah, M. (2020). Principles for advancing game-based learning in teacher education. *Journal of Digital Learning in Teacher Education*, 36(2), 84-95. https://www.researchgate.net/profile/Aroutis-Foster/publication/339345476_Principles_for_Advancing_Game-Based_Learning_in_Teacher_Education/links/5e7ec6af458515efa0b1063b/Principles-for-Advancing-Game-Based-Learning-in-Teacher-Education.pdf
- [16] Jääskä, E., Aaltonen, K., & Kujala, J. (2021). Game-based learning in project sustainability management education. *Sustainability*, 13(15), 8204. <https://www.mdpi.com/2071-1050/13/15/8204/pdf>
- [17] Chang, C. Y., & Hwang, G. J. (2019). Trends in digital game-based learning in the mobile era: a systematic review of journal publications from 2007 to 2016. *International Journal of Mobile Learning and Organisation*, 13(1), 68-90. https://www.researchgate.net/profile/Ching-Yi-Chang/publication/330058812_Trends_in_digital_game-based_learning_in_the_mobile_era_A_systematic_review_of_journal_publications_from_2007_to_2016/links/5ec4687692851c11a8777f13/Trends-in-digital-game-based-learning-in-the-mobile-era-A-systematic-review-of-journal-publications-from-2007-to-2016.pdf?_sg%5B0%5D=started_experiment_milestone&origin=journalDetail
- [18] Breien, F. S., & Wasson, B. (2021). Narrative categorization in digital game-based learning: Engagement, motivation & learning. *British Journal of Educational Technology*, 52(1), 91-111. <https://bera-journals.onlinelibrary.wiley.com/doi/pdf/10.1111/bjet.13004>
- [19] Tokac, U., Novak, E., & Thompson, C. G. (2019). Effects of game-based learning on students' mathematics achievement: A meta-analysis. *Journal of Computer Assisted Learning*, 35(3), 407-420. <https://www.academia.edu/download/67164046/fullpdf.pdf>
- [20] Nadolny, L., Valai, A., Cherrez, N. J., Elrick, D., Lovett, A., & Nowatzke, M. (2020). Examining the characteristics of game-based learning: A content analysis and design framework. *Computers & Education*, 156, 103936. <https://gamicon.bluerabbit.io/br/wp-content/uploads/2021/02/Larysa-Nadolny-Framework.pdf>
- [21] Brezovszky, B., McMullen, J., Veermans, K., Hannula-Sormunen, M. M., Rodríguez-Aflecht, G., Pongsakdi, N., ... & Lehtinen, E. (2019). Effects of a mathematics game-based learning environment on primary school students' adaptive number knowledge. *Computers & Education*, 128, 63-74. https://www.researchgate.net/profile/Boglarka-Brezovszky/publication/327736669_Effects_of_a_mathematics_game-based_learning_environment_on_primary_school_students%27_adaptive_number_knowledge/links/5bab6a12a6fdccd3cb737d02/Effects-of-a-mathematics-game-based-learning-environment-on-primary-school-students-adaptive-number-knowledge.pdf
- [22] Greipl, S., Klein, E., Lindstedt, A., Kiili, K., Moeller, K., Karnath, H. O., ... & Ninaus, M. (2021). When the brain comes into play: Neurofunctional correlates of emotions and reward in game-based learning. *Computers in Human Behavior*, 125, 106946. <https://www.sciencedirect.com/science/article/pii/S0747563221002697>
- [23] Huizenga, J., Admiraal, W., Ten Dam, G., & Voogt, J. (2019). Mobile game-based learning in secondary education: Students' immersion, game activities, team performance and learning outcomes. *Computers in Human Behavior*, 99, 137-143. https://e-tarjome.com/storage/panel/fileuploads/2019-09-30/1569849209_E13642-e-tarjome.pdf
- [24] Ronimus, M., Eklund, K., Pesu, L., & Lyytinen, H. (2019). Supporting struggling readers with digital game-based learning. *Educational Technology Research and Development*, 67(3), 639-663. <https://link.springer.com/article/10.1007/s11423-019-09658-3>