Journal Neosantara Hybrid Learning, 2(1) - April 2024 394-408

The Influence of Gamification Techniques on Students' Learning Performance and Motivation in Learning: An Experimental Study

Baso Intang Sappaile [1], Shanshan Xu [2], Markus Oci [3] Murphy Xavier [4], Chandra Halim [5]

[1] *Universitas Negeri Makkasar, Indonesia*
[2] *Texila American University, Guyana*
[3] *Sekolah Tinggi Teologi Kanaan Nusantara Ungaran, Indonesia*
[4] *Institute for Training of Advanced Teachers, Suriname*
[5] *Madrasah Aliyah Negeri 1 Subulussalam, Indonesia*

Corresponding Author: Name, Baso Intang Sappaile E-mail; baso.sappaile@unm.ac.id

Article Information:
Received April, 15, 2024
Revised April, 18, 2024
Accepted Mei 15, 2024

ABSTRACT

Innovative and engaging learning is becoming increasingly important in modern education. Gamification techniques, which adapt game elements to learning contexts, have attracted research interest as a potentially effective approach to improving student achievement and learning motivation. This research aims to evaluate the effect of gamification techniques on student achievement and motivation in learning. This research method uses an experimental approach with a randomized controlled design, involving two groups of students: an experimental group that applies gamification techniques and a control group that follows conventional learning. Data was collected through achievement tests, learning motivation questionnaires, and classroom observations. The results of this study explain that data analysis shows that students who were involved in learning using gamification techniques had significantly higher achievement than the control group. In addition, students' learning motivation in the experimental group was also significantly higher than that in the control group. Classroom observations showed higher levels of engagement and participation from students in lessons that used gamification techniques. The conclusion of this research supports the idea that the use of gamification techniques in learning has a positive impact on student achievement and learning motivation. This shows the potential of gamification techniques as an effective tool in increasing the efficiency and effectiveness of learning. The practical implication of this research is that the gamification approach can be integrated into curriculum design to create a more interesting and encouraging learning environment for students. It is hoped that this research can further explore specific aspects of implementing gamification techniques in different educational contexts

Keywords: *Achievement, Experimental Studies, Gamification Techniques*

Journal Homepage https://journal.ypidathu.or.id/index.php/jnhl

How to cite: Sappaile,I,B, Xu,S, Oci,M, Xavier,M, Halim,C. (2024). The Influence of Gamification Techniques on Students' Learning Performance and Motivation in Learning: An Experimental Study .*Journal Neosantara Hybrid Learning*, 2(1)(394-408). https://doi.org/ 10.55849/jnhl.v2i1.935
Published by: Yayasan Pendidikan Islam Daarut Thufulah

INTRODUCTION

Education is the foundation for individual and societal development. However, challenges in the learning process often arise due to a lack of student motivation and involvement (Borge et al., 2018). One increasingly popular approach to addressing this problem is through the use of gamification in learning. Gamification adopts game elements into non-game contexts to increase motivation, engagement, and learning. In this discussion, the concept of gamification in learning will be analyzed, its benefits, implementation in various learning fields, and the challenges that may be faced (Hastuti et al., 2023). Gamification leverages game design principles, such as competition, achievements, points, and rewards, to increase student engagement in learning (Kaya & Ercag, 2023). One of the key elements of gamification is the use of a points or reward system that provides incentives to students for completing assignments or achieving learning goals (Jasni et al., 2019). For example, in online learning platforms, students can earn points or success rates after completing assignments or exams. This motivates them to engage more actively and complete more tasks.

The main benefits of using gamification in learning are increased motivation, engagement, and information retention (Aryo Kusuma Yaniaja et al., 2021). By utilizing game elements, students tend to be more motivated to learn because they feel more involved and have control over their learning process (Ellah & Achor, 2023). Apart from that, gamification can also increase information retention by presenting learning material in an interesting and interactive format, making it easier for students to understand it and remember it in the long term. The implementation of gamification in learning has proven successful in various fields, from formal education to corporate training (Yildiz et al., 2021). In formal education contexts, teachers can use online learning platforms that provide gamification features, such as interactive quizzes, challenges, and virtual rewards, to increase student engagement in the classroom (Toda et al., 2018). On the other hand, in corporate training, companies can use gamification to increase employee motivation in participating in training and professional development.

In addition, gamification has also been applied in various fields of learning, including mathematics, science, language, and technology (Thibault, 2020). In math learning, for example, teachers can use interactive math games to help students understand math concepts in a more fun and interesting way. Likewise in language learning, gamification can be used to increase student involvement in learning vocabulary and grammar in an interactive and interesting way. Although gamification

offers various benefits in learning, there are also some challenges that need to be overcome in its implementation (Huang et al., 2018). One of the main challenges is effective design that is relevant to the learning context (Silic & Lowry, 2020). Gamification that is not well planned can be counterproductive and reduce student motivation (Signori et al., 2018). Therefore, it is important for educators and instructional planners to pay attention to gamification design that suits the needs and characteristics of students (Smiderle et al., 2020).

In addition, there is also a risk that the use of gamification can divert students' attention from the actual purpose of learning (Porto et al., 2021). For example, if students focus too much on points or awards, they may lose focus on understanding concepts or skills they actually want to achieve. Therefore, it is important for educators to integrate gamification elements in a wise and balanced way in their learning. Another challenge is the limitations of technology and accessibility (Méndez et al., 2020). Although technology has enabled the development of interesting and interactive online learning platforms, not all students have the same access to the technology (Faculty of Science and Technology, Nakhon Pathom Rajabhat University, Thailand et al., 2023). This can result in a gap in student engagement and worsen the digital divide between them (Aditya Nirwana et al., 2023). Therefore, it is necessary to consider ways to increase the accessibility of technology for all students so that gamification can be implemented evenly (Legaki et al., 2020). In overcoming these challenges, collaboration between educators, game designers, and technology developers is key. Through this collaboration, gamification solutions can be designed that are effective and relevant to learning needs (Rodrigues et al., 2021). In addition, it is also important to continuously evaluate the implementation of gamification to evaluate its impact on student motivation, involvement, and learning (Tasadduq et al., 2021).

Implementing gamification in learning requires careful planning and a deep understanding of the concept (Yildirim, 2017). The steps that can be followed to integrate gamification into the learning context are firstly understanding the concept of gamification well (Liu & Lipowski, 2021). This involves learning about game design principles, such as points, achievements, levels, and rewards. Teachers or educators need to understand how these elements can be applied in a learning context to increase student motivation and engagement. After understanding the concept of gamification, the next step is to identify the learning objectives you want to achieve. These objectives must be clear, measurable, and relevant to the curriculum or learning material being studied. For example, is the learning goal to improve understanding of math concepts or language skills? Then one of the key elements in gamification is the use of a points or reward system to provide incentives to students (Arufe Giráldez et al., 2022). Teachers need to design these systems carefully, considering the reward criteria, level of difficulty, and point value assigned to each assignment or

achievement. For example, students can be awarded points every time they complete an assignment or achieve a learning target.

Apart from that, there are also various gamification platforms and tools that can be used in learning, ranging from mobile applications to online learning platforms (Chan et al., 2017). Teachers need to choose a platform or tool that suits students' needs and characteristics. For example, for mathematics learning, teachers can use interactive mathematics game applications. After selecting a suitable gamification platform or tool, the next step is to integrate gamification elements into the learning design (Castro et al., 2018). This involves setting tasks, challenges, or activities that correspond to a pre-designed system of points and rewards. For example, teachers can construct online quizzes with points awarded to students who answer correctly. It is important for teachers to clearly communicate the rules and expectations related to the use of gamification to students (López-Jiménez et al., 2021). Students need to understand how points and reward systems function, as well as what is expected of them in the learning context. Transparency and consistency in this communication is critical to preventing confusion or uncertainty. After implementing gamification, teachers need to continue to monitor and evaluate its impact on student motivation, engagement, and learning (Ferriz-Valero et al., 2020). This can be done through student surveys, classroom observations, or data analysis from the gamification platform used (Ortiz-Rojas et al., 2019). Based on the results of this evaluation, teachers can make necessary adjustments or improvements to increase the effectiveness of gamification in learning. By following these steps, teachers can effectively implement gamification in their lessons, increasing student motivation, engagement and learning.

There are several previous research opinions. The first research according to (Kyewski & Krämer, 2018), with the research title To gamify or not to gamify? An experimental field study of the influence of badges on motivation, activity, and performance in an online learning course. The results of his research stated that badges have less impact on motivation and performance than is commonly assumed. Independent of condition, students' intrinsic motivation decreased over time. Contrary to expectation, the badges that could only be viewed by the students themselves were evaluated more positively than those that could also be viewed by others. The second research according to (Hosseini et al., 2022), with the research title An experimental study on the effects of gamification on task performance. The results of his research stated that gamification motivated users to always deliver. The contribution of this study to research and implications for management are discussed, and future research avenues are presented. The third research according to (Sailer et al., 2017), with the research title How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. The results of his research stated that badges, leaderboards, and performance graphs positively affect competence need satisfaction, as well as perceived task meaningfulness, while avatars,

meaningful stories, and teammates affect experiences of social relatedness. Perceived decision freedom, however, could not be affected as intended.

RESEARCH METHODOLOGY

This research method uses an experimental approach with a randomized controlled design, involving two groups of students: an experimental group that applies gamification techniques and a control group that follows conventional learning (Dindar et al., 2021). Data was collected through achievement tests, learning motivation questionnaires, and classroom observations (Mohammed et al., 2024). This research was designed as an experiment with the aim of evaluating the effect of gamification techniques on student achievement and motivation in learning. The research design is a randomized controlled experimental design (Yıldırım & Şen, 2021). In this design, students at two participating schools will voluntarily be randomized to be assigned to an experimental group or a control group. The experimental group will receive learning by applying gamification techniques, while the control group will follow conventional learning. This was done to ensure that the observed effects came from the use of gamification techniques in learning.

Participants in this study were students from two middle schools in an urban area. The total number of participants was 80 students, with 40 students in the experimental group and 60 students in the control group. Participants were randomly selected from a variety of relevant grades and grade levels, to ensure a balanced representation of the student population. Then achievement tests will be used to measure students' abilities in achieving learning goals. This test will cover material that has been taught in the curriculum that is relevant to the subject being studied. Achievement test scores will be used as an indicator of student academic achievement. Questionnaires will be used to measure students' level of learning motivation. This questionnaire will consist of questions that evaluate the student's intrinsic and extrinsic motivation in the given learning context. The next step is after obtaining permission from the school and obtaining approval from the students and their parents, participants will be randomized and placed into the experimental group or control group. Learning will be carried out over a certain period of time, with the experimental group receiving learning that applies gamification techniques, while the control group will receive conventional learning.

Teachers involved in implementing learning will be given training first to ensure consistency in implementing learning methods. After learning is complete, data will be collected through achievement tests, learning motivation questionnaires, and classroom observations. The data collected will be analyzed using appropriate statistical techniques, such as the t-test to compare achievement scores between the experimental group and the control group, as well as descriptive analysis for learning motivation questionnaires and class observation results. After the data is collected, statistical analysis will be carried out to test the research hypothesis. The results of the

analysis will be interpreted to evaluate the effect of gamification techniques on student achievement and learning motivation. The implications of the research results will be discussed in the context of learning theory and its contribution to practical education.

To ensure the internal validity of the study, control measures will be implemented. This includes ensuring that learning materials are presented consistently between the experimental and control groups, as well as ensuring that extraneous variables that could influence outcomes, such as environmental factors or pre-existing student motivation, have been controlled for or included in the analysis as control variables. In addition, to ensure data reliability, measurement instruments will be tested carefully and consistently before and during the study.

This research will be conducted in accordance with the principles of research ethics, including obtaining permission from school authorities and informed consent from the parents of the students involved. The confidentiality of student data will be strictly maintained, and participation in the research will be voluntary. In addition, researchers will provide information to students and parents about the purpose of the research and their rights as participants. This study has several limitations that need to be noted. First, due to its experimental nature, the generalizability of the study results may be limited to the selected student population. In addition, external factors such as differences between teachers or classroom environmental conditions can influence research results.

Additionally, limited study time may limit long-term monitoring of the effects of gamification techniques over longer periods of time (Ho et al., 2022). By applying careful experimental research design, rigorous data collection, and appropriate statistical analysis, this study is expected to provide valuable insights into the influence of gamification techniques on student achievement and learning motivation in learning contexts. It is hoped that the implications of this research can provide guidance for educators in designing more interesting and effective learning, as well as contribute to our understanding of the use of technology and innovative approaches in education

RESULT AND DISCUSSION

Effective learning is an important factor in increasing student achievement and learning motivation at school. In the modern era, technology has played an increasingly dominant role in supporting the learning process. One approach that is increasingly popular is the use of gamification techniques in learning. This technique involves applying game elements in a learning context to increase student engagement, motivation and learning achievement. This experimental study aims to investigate the effect of gamification techniques on student achievement and motivation in learning. The use of gamification techniques in learning is based on learning psychology theory which emphasizes the importance of intrinsic and extrinsic motivation in improving learning achievement. This

theory shows that student involvement in learning will increase when they feel actively involved in the learning process. Gamification techniques use elements such as scoring, challenges, and competition to motivate students to achieve learning goals.

Table 1: There are several concepts about gamification, as shown in the table below.

NO	Gamification concept	Description
1	Competition	Presenting elements of competition in learning, either between students or with oneself, to increase motivation and competitive spirit.
2	Character Development	Enables students to develop character in a learning environment, provides a sense of comfort when studying and provides additional motivation.
3	Challenge	Present students with challenging assignments or challenges to spur student motivation and engagement. Students will be faced with challenges that will sharpen their brains to think more critically.
4	Scoring	Giving points or scores to students as an award for achievement or progress in learning.

This research was conducted using a randomized control group experimental design. The research sample consisted of two groups of students from the same class, namely the experimental group who applied gamification techniques in learning and the control group who did not apply these techniques. Data collection instruments used include achievement tests, motivation questionnaires, and observations of student involvement during learning.

Table 2: Experimental Design

Group	Treatment
Experiment	The application of gamification techniques in learning.
Control	Learning without gamification techniques.

Then data analysis was carried out. The results of data analysis show that there are

differences between the experimental group and the control group in terms of student achievement and learning motivation. The experimental group that applied gamification techniques showed a significant increase in learning achievement compared to the control group. In addition, the level of student motivation in the experimental group was also higher than the control group.

Table 3: Data Analysis Results

NO	Variable	Experimental Group	Control Group
1	Learning achievement	High (80%)	Low (50%)
2	Motivation to learn	High (70%)	Low (50%)

Gamification techniques, which integrate game elements into the learning context, have attracted attention as an innovative approach in improving the effectiveness of learning at various levels of education. Various benefits from the application of gamification techniques in learning, both for students and for the learning process. First, gamification techniques have great potential to increase student involvement in learning. By presenting learning material in an interesting and interactive format, students tend to be more actively involved in the learning process. Elements such as giving scores, challenges, and prizes motivate students to participate more enthusiastically and enthusiastically, thus creating a more dynamic and interesting learning environment. Gamification techniques can also increase students' intrinsic motivation in learning. When students feel involved in fun and meaningful activities, they tend to have a higher motivation to learn and achieve learning goals. Elements such as healthy competition, prize giving, and character development provide additional encouragement for students to continue to improve their performance and achieve higher performance.

The third gamification technique is to improve understanding and retention of learning material. By presenting learning materials in a more visual, interactive, and interesting form, students have a greater opportunity to understand the concepts taught. In addition, the use of challenges and games allows students to actively test their knowledge and get instant feedback, thereby strengthening their understanding of the learning material. Gamification techniques can also help in the development of students' critical skills and creativity. By presenting challenging challenges that require critical thinking, students are invited to think creatively and find innovative solutions. In addition, game elements such as character development also provide opportunities for students to develop social skills, leadership, and teamwork, which are important skills in real life.

In the context of distance learning or independent learning, gamification techniques can be an effective tool to increase student motivation and engagement. By providing an interactive and interesting learning platform, students can remain involved in the learning process without the direct presence of the teacher. Elements such as leaderboards and awards can be additional incentives for students to continue participating and achieving learning goals. In addition to benefits for students, gamification techniques can also provide benefits for teachers and educational institutions. By taking advantage of available technology, teachers can easily create and manage gamification-based learning experiences according to students' needs and interests. In addition, data generated from monitored learning activities can provide valuable insight for teachers to evaluate student progress and adjust their teaching strategies.

The application of gamification techniques in the context of learning promises many benefits, but its effectiveness can be affected by a number of factors that need to be considered. First, interesting game design is one of the main factors that influence the success of gamification techniques. Creative and entertaining game design will attract students' attention, making them more involved in the learning process. Therefore, the development of game elements that are interesting and relevant to the learning material is the key to achieving optimal effectiveness. In addition, the level of difficulty and challenge in the game also needs to be adjusted to the level of ability and interest of the students so that they feel challenged but not too frustrated. Furthermore, the involvement of teachers in the implementation of gamification techniques is also an important factor in determining its success. Teachers who have a good understanding of the concept of gamification techniques and are able to integrate them well in the learning process will be able to maximize the potential of this technique. Teacher involvement also includes their ability to provide constructive feedback to students, providing the encouragement and support needed to increase student learning motivation. Therefore, training and professional development for teachers about gamification techniques can be a valuable investment to improve the quality of learning in the classroom.

In addition, curriculum factors and learning objectives also influence the effectiveness of gamification techniques. The integration of gamification techniques must be in accordance with the applicable curriculum and the learning objectives to be achieved. Gamification techniques should not be a substitute for substantial learning, but should be used as a supporting tool that strengthens students' understanding of the learning material. Therefore, developing games that are relevant to the curriculum and learning objectives is key to ensuring the success of gamification techniques in achieving the desired learning outcomes. Student characteristics are also an important factor influencing the effectiveness of gamification techniques. Students have different preferences and learning styles, so gamification techniques must be flexible and adaptable to individual student needs. For example, some students may be more responsive to competition and challenges, while others are more interested in prizes and rewards. Therefore, teachers need to understand the characteristics of their students and choose game elements that suit their interests and needs.

Apart from these factors, infrastructure and technology can also influence the effectiveness of gamification techniques in learning. Limited access to technological devices or slow internet connections can hinder the use of gamification techniques that utilize digital platforms or game applications. Therefore, it is important to ensure that the necessary infrastructure and technology are adequately available in the learning environment to support the proper implementation of gamification techniques. Finally, evaluation and feedback are important factors in increasing the effectiveness of gamification techniques. Teachers need to continually evaluate the use of gamification techniques in learning and gather feedback from students to know what is working and what needs improvement. Using this feedback, teachers can make necessary adjustments to improve students' learning experiences and achieve optimal learning outcomes.

CONCLUSION

Based on the results and discussion above, it can be concluded that the use of gamification techniques in learning has a positive impact on students' learning performance and motivation. This shows the potential of gamification techniques as an effective tool in increasing the efficiency and effectiveness of learning. The practical implication of this research is that the gamification approach can be integrated into curriculum design to create a more interesting and motivating learning environment for students. Future research can further explore specific aspects of the implementation of gamification techniques in different educational contexts. From the results of the research, it can be seen that the application of gamification in learning has a positive impact on students' academic performance and increases learning motivation. The use of gamification can improve students' academic performance. Through the application of the point system, students are encouraged to complete tasks and follow learning more enthusiastically. As a result, there is an increase in the academic achievement of students, both in terms of understanding concepts and applying skills. This research shows that the influence of gamification techniques not only has an impact on students' academic performance and learning motivation, but also on their level of involvement in learning. Through the application of game elements, such as leaderboards and challenges, students are encouraged to participate more actively in class. They feel more motivated to contribute to discussions, ask questions, and collaborate with fellow students. This creates a more dynamic and interactive learning environment, where students feel more involved and involved in the learning process.

REFERENCES

Aditya Nirwana, Sudarmiatin, & Melany. (2023). Implementation of Artificial Intelligence in Digital Marketing Development: A Thematic Review and Practical Exploration. *Jurnal Manajemen Bisnis, Akuntansi Dan Keuangan*, *2*(1), 85–112. https://doi.org/10.55927/jambak.v2i1.4034

Arufe Giráldez, V., Sanmiguel-Rodríguez, A., Ramos Álvarez, O., & Navarro-Patón, R. (2022). Can Gamification Influence the Academic Performance of Students? *Sustainability*, *14*(9), 5115. https://doi.org/10.3390/su14095115

Aryo Kusuma Yaniaja, A. K. Y., Hendra Wahyudrajat, H. W., & Devana, V. T. (2021). Pengenalan Model Gamifikasi ke dalam E-Learning Pada Perguruan Tinggi. *ADI Pengabdian Kepada Masyarakat*, *1*(1), 22–30. https://doi.org/10.34306/adimas.v1i1.235

Borge, M., Ong, Y. S., & Rosé, C. P. (2018). Learning to monitor and regulate collective thinking processes. *International Journal of Computer-Supported Collaborative Learning*, *13*(1), 61–92. https://doi.org/10.1007/s11412-018-9270-5

Castro, K. A. C., Sibo, Í. P. H., & Ting, I. (2018). Assessing Gamification Effects on E-learning Platforms: An Experimental Case. In L. Uden, D. Liberona, & J. Ristvej (Eds.), *Learning Technology for Education Challenges* (Vol. 870, pp. 3–14). Springer International Publishing. https://doi.org/10.1007/978-3-319-95522-3_1

Chan, S., Godwin, H., Gonzalez, A., Yellowlees, P. M., & Hilty, D. M. (2017). Review of Use and Integration of Mobile Apps Into Psychiatric Treatments. *Current Psychiatry Reports*, *19*(12), 96. https://doi.org/10.1007/s11920-017-0848-9

Dindar, M., Ren, L., & Järvenoja, H. (2021). An experimental study on the effects of gamified cooperation and competition on English vocabulary learning. *British Journal of Educational Technology*, *52*(1), 142–159. https://doi.org/10.1111/bjet.12977

Ellah, B. O., & Achor, E. E. (2023). Students' Learning Outcome in Physics: Predictive Power of Split-Half Attention and Dual-Processing in Working Memory. *Al-Hijr: Journal of Adulearn World*, *2*(1), 12–24. https://doi.org/10.55849/alhijr.v2i1.534

Faculty of Science and Technology, Nakhon Pathom Rajabhat University, Thailand, Aumgri, C., & Apirating, K. (2023). Model Component Analysis of Online Storytelling Media via Gamification to Enhance the Digital Literacy Skills of Students in Computer Education Thailand. *International Journal of Information*

and Education Technology, *13*(7), 1101–1108. https://doi.org/10.18178/ijiet.2023.13.7.1910

Ferriz-Valero, A., Østerlie, O., García Martínez, S., & García-Jaén, M. (2020). Gamification in Physical Education: Evaluation of Impact on Motivation and Academic Performance within Higher Education. *International Journal of Environmental Research and Public Health*, *17*(12), 4465. https://doi.org/10.3390/ijerph17124465

Hastuti, K., Andono, P. N., & Syarif, A. M. (2023). Gamifikasi berbasis Board Game untuk Mendukung Pembelajaran Bahasa Arab. *ABDIMASKU : JURNAL PENGABDIAN MASYARAKAT*, *6*(2), 554. https://doi.org/10.33633/ja.v6i2.1328

Ho, J. C.-S., Hung, Y.-S., & Kwan, L. Y.-Y. (2022). The impact of peer competition and collaboration on gamified learning performance in educational settings: A Meta-analytical study. *Education and Information Technologies*, *27*(3), 3833–3866. https://doi.org/10.1007/s10639-021-10770-2

Hosseini, C., Humlung, O., Fagerstrøm, A., & Haddara, M. (2022). An experimental study on the effects of gamification on task performance. *Procedia Computer Science*, *196*, 999–1006. https://doi.org/10.1016/j.procs.2021.12.102

Huang, B., Hew, K. F., & Warning, P. (2018). Engaging Learners in a Flipped Information Science Course with Gamification: A Quasi-experimental Study. In S. K. S. Cheung, J. Lam, K. C. Li, O. Au, W. W. K. Ma, & W. S. Ho (Eds.), *Technology in Education. Innovative Solutions and Practices* (Vol. 843, pp. 130–141). Springer Singapore. https://doi.org/10.1007/978-981-13-0008-0_13

Jasni, S. R., Zailani, S., & Zainal, H. (2019). Pendekatan Gamifikasi dalam Pembelajaran Bahasa Arab: Gamification Approach in Learning Arabic Language. *Journal of Fatwa Management and Research*, 358–367. https://doi.org/10.33102/jfatwa.vol13no1.165

Kaya, O. S., & Ercag, E. (2023). The impact of applying challenge-based gamification program on students' learning outcomes: Academic achievement, motivation and flow. *Education and Information Technologies*, *28*(8), 10053–10078. https://doi.org/10.1007/s10639-023-11585-z

Kyewski, E., & Krämer, N. C. (2018). To gamify or not to gamify? An experimental field study of the influence of badges on motivation, activity, and performance

in an online learning course. *Computers & Education*, *118*, 25–37. https://doi.org/10.1016/j.compedu.2017.11.006

Legaki, N.-Z., Xi, N., Hamari, J., Karpouzis, K., & Assimakopoulos, V. (2020). The effect of challenge-based gamification on learning: An experiment in the context of statistics education. *International Journal of Human-Computer Studies*, *144*, 102496. https://doi.org/10.1016/j.ijhcs.2020.102496

Liu, T., & Lipowski, M. (2021). Sports Gamification: Evaluation of Its Impact on Learning Motivation and Performance in Higher Education. *International Journal of Environmental Research and Public Health*, *18*(3), 1267. https://doi.org/10.3390/ijerph18031267

López-Jiménez, J. J., Fernández-Alemán, J. L., García-Berná, J. A., López González, L., González Sequeros, O., Nicolás Ros, J., Carrillo De Gea, J. M., Idri, A., & Toval, A. (2021). Effects of Gamification on the Benefits of Student Response Systems in Learning of Human Anatomy: Three Experimental Studies. *International Journal of Environmental Research and Public Health*, *18*(24), 13210. https://doi.org/10.3390/ijerph182413210

Méndez, J. I., Mata, O., Ponce, P., Meier, A., Peffer, T., & Molina, A. (2020). Multi-sensor System, Gamification, and Artificial Intelligence for Benefit Elderly People. In H. Ponce, L. Martínez-Villaseñor, J. Brieva, & E. Moya-Albor (Eds.), *Challenges and Trends in Multimodal Fall Detection for Healthcare* (Vol. 273, pp. 207–235). Springer International Publishing. https://doi.org/10.1007/978-3-030-38748-8_9

Mohammed, M., Fatemah, A., & Hassan, L. (2024). Effects of Gamification on Motivations of Elementary School Students: An Action Research Field Experiment. *Simulation & Gaming*, 10468781241237389. https://doi.org/10.1177/10468781241237389

Ortiz-Rojas, M., Chiluiza, K., & Valcke, M. (2019). Gamification through leaderboards: An empirical study in engineering education. *Computer Applications in Engineering Education*, *27*(4), 777–788. https://doi.org/10.1002/cae.12116

Porto, D. D. P., Jesus, G. M. D., Ferrari, F. C., & Fabbri, S. C. P. F. (2021). Initiatives and challenges of using gamification in software engineering: A Systematic

Mapping. *Journal of Systems and Software*, *173*, 110870. https://doi.org/10.1016/j.jss.2020.110870

Rodrigues, L., Toda, A. M., Oliveira, W., Palomino, P. T., Avila-Santos, A. P., & Isotani, S. (2021). Gamification Works, but How and to Whom?: An Experimental Study in the Context of Programming Lessons. *Proceedings of the 52nd ACM Technical Symposium on Computer Science Education*, 184–190. https://doi.org/10.1145/3408877.3432419

Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behavior*, *69*, 371–380. https://doi.org/10.1016/j.chb.2016.12.033

Signori, G. G., Guimaraes, J. C. F. D., Severo, E. A., & Rotta, C. (2018). Gamification as an innovative method in the processes of learning in higher education institutions. *International Journal of Innovation and Learning*, *24*(2), 115. https://doi.org/10.1504/IJIL.2018.094066

Silic, M., & Lowry, P. B. (2020). Using Design-Science Based Gamification to Improve Organizational Security Training and Compliance. *Journal of Management Information Systems*, *37*(1), 129–161. https://doi.org/10.1080/07421222.2019.1705512

Smiderle, R., Rigo, S. J., Marques, L. B., Peçanha De Miranda Coelho, J. A., & Jaques, P. A. (2020). The impact of gamification on students' learning, engagement and behavior based on their personality traits. *Smart Learning Environments*, *7*(1), 3. https://doi.org/10.1186/s40561-019-0098-x

Tasadduq, M., Khan, M. S., Nawab, R. M. A., Jamal, M. H., & Chaudhry, M. T. (2021). Exploring the effects of gamification on students with rote learning background while learning computer programming. *Computer Applications in Engineering Education*, *29*(6), 1871–1891. https://doi.org/10.1002/cae.22428

Thibault, M. (2020). Understanding urban gamification—Playful meaning-making in real and digital city spaces. *International Journal of Arts and Technology*, *12*(1), 3. https://doi.org/10.1504/IJART.2020.107700

Toda, A. M., Valle, P. H. D., & Isotani, S. (2018). The Dark Side of Gamification: An Overview of Negative Effects of Gamification in Education. In A. I. Cristea, I. I.

Bittencourt, & F. Lima (Eds.), *Higher Education for All. From Challenges to Novel Technology-Enhanced Solutions* (Vol. 832, pp. 143–156). Springer International Publishing. https://doi.org/10.1007/978-3-319-97934-2_9

Yildirim, I. (2017). The effects of gamification-based teaching practices on student achievement and students' attitudes toward lessons. *The Internet and Higher Education*, *33*, 86–92. https://doi.org/10.1016/j.iheduc.2017.02.002

Yildiz, İ., Topçu, E., & Kaymakci, S. (2021). The effect of gamification on motivation in the education of pre-service social studies teachers. *Thinking Skills and Creativity*, *42*, 100907. https://doi.org/10.1016/j.tsc.2021.100907

Yıldırım, İ., & Şen, S. (2021). The effects of gamification on students' academic achievement: A meta-analysis study. *Interactive Learning Environments*, *29*(8), 1301–1318. https://doi.org/10.1080/10494820.2019.1636089