Journal of Advanced Sciences and Mathematics Education
Volume 5, Issue 1, 113 - 121.
e_ISSN: 2798-2351
DOI: 10.58524/jasme.v5i1.519

Academic achievement and students' satisfaction towards inquiry-based learning and gamification of grade 7 students

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Article Info

Article history:

Received: January 19, 2025
Revised: Feburary 04, 2025
Accepted: March 22, 2025

Keywords:

Inquiry-Based Learning;
Gamification;
Learning Achievement;
Satisfaction.

Abstract

Background: Effective science education should promote not only academic achievement but also student motivation and engagement. Integrating inquiry-based learning with gamification has been suggested as a promising approach to support these outcomes, especially in middle school contexts where students often face challenges in understanding abstract scientific concepts.
Aim: This study aims to evaluate the academic achievement and satisfaction of Grade 7 students after learning thermal energy concepts through inquiry-based learning integrated with gamification. The target benchmark was set at 70% achievement to assess the effectiveness of the learning model.
Method: A post-test only experimental design was employed with 39 Grade 7 students at Kalasin Pittayasan School. The intervention involved four learning sessions that applied inquiry-based strategies enhanced with gamified activities. Research instruments included lesson plans, a 10-item multiple-choice academic achievement test, and a student satisfaction questionnaire. Data were analyzed using descriptive statistics and one-sample t-tests.
Results: Findings revealed that students' average achievement score (73.80%) significantly exceeded the 70% criterion ($p < 0.05$). Students also reported high satisfaction with the learning experience, citing improved understanding, enjoyment, and motivation. Qualitative feedback highlighted a positive classroom environment, increased willingness to participate, and appreciation for game-based elements.
Conclusion: The integration of gamification within inquiry-based learning can effectively enhance both academic performance and learner satisfaction in science education. This approach offers a meaningful instructional model for middle school science classes. Future research should explore its long-term impact and adaptability across different subjects and student populations.

To cite this article: Khotphat, P., Nuangchalern, P., & Saregar, A. (2025). Academic acievement and students' satisfication towards inquiry-based learning and gamification of grade 7 students. *Journal of Advanced Sciences and Mathematics Education, 5*(1), 113 - 121.

INTRODUCTION

Science is relevant to everyone who can study an area of study, both right now and in the future. Science seeks to foster logical and consequential thinking, creativity, analytical thinking, and self-research (Lu, 2024; Sullivan, 2020). Science is the culture of the contemporary world civilization (Lam, 2024). Science education helps our society manage a complicated and technologically driven environment, advancing society (Macgilchrist et al., 2020). As we known, science is very important to present and the future that is students should be learned science through inquiry. Science education fosters curiosity and inquiry to study the natural world, comprehend its phenomena, and enhance life (Fraisl et al., 2022). Science education shapes knowledgeable and involved citizens beyond academic achievements. It teaches scientific ideas and applications to assist people in making educated personal and professional choices.

Through inquiry-based learning and gamification, scientific education may become more interesting, inclusive, and effective, ensuring that all students can benefit from excellent science

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teaching (Bybee, 2002; Constantinou et al., 2018). The inquiry-based learning can make students success in science learning and leading them to autonomous learners. Education systems worldwide are continually evolving to meet the diverse needs of students in the 21st century. Among the various pedagogical approaches, inquiry-based learning has gained prominence for fostering critical thinking, problem-solving skills, and active engagement among learners (Chu et al., 2017; Prachagool & Nuangchalerm, 2021).

Science subject requires students to learn science based on curiosity and understanding scientific concepts. Moreover, it encourages students to explore, question, and construct knowledge, inquiry-based learning aligns well with the goals of modern education, particularly in enhancing academic achievement and fostering positive attitudes toward learning (Prachagool & Nuangchalerm, 2019; Safkolam et al., 2024). Simultaneously, gamification has emerged as a transformative educational tool, leveraging game design elements to boost motivation, participation, and satisfaction in learning environments. The combination of gamification with inquiry-based learning holds promises as a novel pedagogical strategy that can create an engaging and effective learning atmosphere (Bantaokul & Polyiem, 2022; Kalogiannakis et al., 2021; Papadakis et al., 2023; Zhang et al., 2025).

The study aims to investigate students' learning achievement and satisfaction toward inquiry-based learning with gamification. This combined approach is increasingly being adopted to engage students in science learning and provide deeper understanding through active participation (AlAfnan, 2025; Chengere et al., 2025; Conde-Izquierdo et al., 2025). Numerous studies have highlighted the effectiveness of inquiry-based approaches in fostering science process skills, emotional intelligence, and conceptual understanding (Özcan & and Gücüm, 2025; Prayitno et al., 2017; Sharma et al., 2023; Teke & Çalışıcı, 2025). Meanwhile, gamification has also been recognized for enhancing student motivation, engagement, and learning outcomes in diverse educational contexts (DiCesare et al., 2025; Elsawah, 2025; Fathi Najafi et al., 2025; Ortiz-Rojas et al., 2025). Despite these individual benefits, studies combining both strategies remain limited (Ateş & Polat, 2025; Chen & Chu, 2024; Jong et al., 2024). Therefore, this study provides a novel contribution by exploring the synergistic impact of inquiry-based learning integrated with gamification on both academic achievement and student satisfaction. The findings are expected to offer meaningful implications for designing engaging and developmentally appropriate science learning environments.

METHOD

Research Design

This study employed a quantitative post-test only experimental design. The purpose was to examine the effects of an instructional model that integrates inquiry-based learning and gamification (independent variable) on students' academic achievement and learning satisfaction (dependent variables). The learning activities focused on the science topic of thermal energy and were implemented across four lesson sessions. Students were assessed after the intervention without a pre-test comparison.

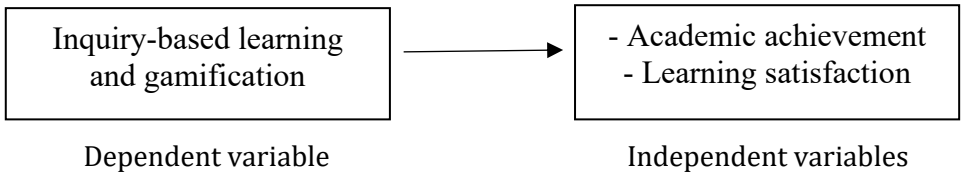

Figure 1. The Variables of Study

Participants

Participants consisted of 39 Grade 7 students from Kalasin Pittayasan School, Thailand, during the second semester of the 2023 academic year. The class was selected using purposive sampling based on the appropriateness of the topic and accessibility. The students experienced the learning through structured inquiry stages supported by gamified activities such as team-based competitions, point rewards, and engaging visual content.

Instrument

Three instruments were employed in this study:

1. Lesson Plans: Four instructional sessions using inquiry-based strategies integrated with gamification techniques tailored to thermal energy content.
2. Academic Achievement Test: A 10-item multiple-choice test designed to assess students' understanding of thermal energy concepts after the intervention.
3. Learning Satisfaction Questionnaire: An open-ended and structured perception questionnaire used to evaluate students' feelings about the learning process, materials, classroom atmosphere, and engagement.

All instruments were reviewed by three content experts to ensure content validity. Adjustments were made based on expert feedback to improve clarity and relevance. Although reliability coefficients were not reported, instruments were refined to align with instructional objectives and student level.

Data Analysis

Academic achievement data were analyzed using a one-sample t-test to compare the mean post-test score against the expected criterion score of 70%. The significance level was set at .05. Descriptive statistics (mean, standard deviation, percentage) were used to summarize quantitative data. Students' responses to the satisfaction questionnaire were analyzed using qualitative content analysis, categorizing recurring themes from their written feedback related to learning experience, engagement, and classroom environment.

RESULTS AND DISCUSSION

Results

The finding revealed that after students learned through inquiry-based learning with gamification can gain their achievement score higher than 70% at .05 level of statistical significance (Table 1).

Table 1. Academic achievement of students

N	k	$\bar{x}$	SD	μ_0	t
39	10	7.38	0.815	7	2.948*

Students had 7.38 of 73.80% of mean score which higher than 70% of full score. They reach the goal of achievement by inquiry-based learning with game mutation techniques significantly exceeding the threshold by 70%. The perception of learning towards this approach tends to be positively responded. It can be summarized in Table 2.

Table 2. Some perceptions of students towards learning organization

Key question	Question	Students' perception
1. Learning activities	1.1 What are the students' opinions on the organization of learning activities in the science of thermal energy using inquiry-based learning with gamification techniques?	□ I can learn through understanding □ I like it when I calculate it and give it away □ It was a lot of fun, my team got the champion □ I don't like to calculate, but I have more understanding □ It's fun, I've never studied like this □ When you compete with the calculations, play the snake ladder game. It's a lot of fun, but I can't keep up with my friends □ I like to study science more than I think that science is very difficult
	1.2 What are the students' opinions on the learning materials	□ Easy to use media □ The teacher's slides are easy to understand □ I want the teacher to add a lot of pictures for more understanding
2. Classroom atmosphere	2.1 What is the atmosphere in the classroom?	□ Very comfortable, the teacher is not cruel, I dare to ask a question □ It's very fun, I like to do activities with my friends because I help each other do it, it's more comfortable than doing it alone □ Friends answer questions too loudly, their ears will break □ Rarely get along with friends I have few friends, so it is difficult to study in a group □ Good, I like that the classroom is not chaotic □ It's not sleepy □ When I play the game, it's very fun □ Feel comfortable when studying because it is not pressured
	2.2 How do students have fun and interest in learning?	□ I don't study with stress, I can collect points to win □ Same as before because I can't answer in time with my friend □ More interested because friends don't invite you to talk during class □ More fun because you can answer questions, even if you answer the wrong teacher □ More than ever because it is not stressful

- Study that is like playing, the teacher is kind, and the content is easy to understand

Students can learn content that is difficult to understand or content that involves calculations in a fun and novel way. They can do and learn on their own through fun activities. The points or prizes are given to encourage students to be more interested in the content. In terms of teaching materials, the students expressed that the medium is user-friendly and simple to comprehend. It is not complicated, and it is suitable for the context of learning in the classroom.

The atmosphere in the classroom is fun, and there is a sense of freedom. Teachers are friendly with students and can discuss and inquire in a rational and effective manner, including the interaction of students with students during class. Most students have more fun and are interested in the content. A minority of students perceive group activities as challenging due to their lack of closeness or difficulty in fostering positive relationships with their peers.

The results showed that the students who were organized learning activities using gamifications had consistent behaviour of participating in learning, high academic achievement, and satisfaction with the organization of learning activities. Most students reported that they independently learned through enjoyable activities and received points or prizes to boost their interest in the content.

Inquiry-based learning with gamification engages students with difficult content through fun activities. The idea of making difficult or calculation-intensive content engaging suggests the importance of active learning strategies. When students find the learning process enjoyable, it reduces anxiety associated with challenging topics, fostering a positive perception toward learning (Aidoo et al., 2024; Ferreira et al., 2022; Nzomo et al., 2023). Gamification, hands-on experiments, or digital simulations can serve as examples of such methods. These approaches not only make the subject matter approachable but also enhance long-term retention by associating learning with positive emotions.

This approach helps students meet the concept of autonomous learning. Students can do and learn on their own. It is a hallmark of constructivist learning theory. The learning activities allow students participating in enjoyable activities, students become active participants in their education, promoting critical thinking and problem-solving skills. Autonomous learning also empowers students to take responsibility for their progress, which can lead to improved self-confidence and motivation (Chu et al., 2017).

The learning activities use points and prizes for leading students' motivation. Providing rewards such as points or prizes taps into intrinsic and extrinsic motivation (Joseph Anthony Nietes et al., 2024). While these incentives can spark initial interest and engagement, it is essential to ensure they do not overshadow intrinsic goals, such as a genuine curiosity about the subject matter. Striking a balance ensures that students remain motivated even without tangible rewards, fostering a lifelong love of learning (Fang, 2022). The emphasis on simplicity and user-friendliness in teaching materials reflects an understanding of students' cognitive load. Overly complex materials can hinder comprehension and discourage engagement. Materials tailored to classroom contexts enhance accessibility and ensure alignment with curricular goals.

In conclusion, the described classroom environment highlights the importance of fostering an engaging, interactive, and supportive space for students to learn effectively. The positive atmosphere, friendly teacher-student relationships, and collaborative dynamics largely enhance student interest and enjoyment. However, addressing the challenges faced by a minority of students in group activities is crucial to ensure inclusivity and equitable learning opportunities. Incorporating tailored

support, varied activities, and fostering a culture of empathy and collaboration, teachers can create a more balanced environment that benefits all students.

Discussion

The results of this study demonstrated that the integration of inquiry-based learning and gamification effectively improved students' academic performance in science, as evidenced by a mean score of 73.80%, which surpassed the 70% criterion. This supports prior findings that inquiry-based learning fosters deeper conceptual understanding and critical thinking through exploration and student-driven investigation (Chu et al., 2017; Ferreira et al., 2022). The gamified activities such as point systems, competitive games, and collaborative learning appeared to enhance motivation, as students were more engaged and active in learning.

Moreover, student perceptions revealed that the learning experience was enjoyable, interactive, and less stressful. Many students appreciated the balance between challenge and play, which is consistent with research suggesting that gamification can reduce cognitive pressure and increase learning enjoyment (Fang, 2022; Joseph Anthony Nietes et al., 2024). However, a few students reported difficulties in keeping pace or collaborating in groups, indicating the need to consider individual learning differences and group dynamics more carefully. These findings highlight that while gamification can enhance the classroom environment, it must be thoughtfully designed to ensure inclusivity.

Implications

This study offers valuable pedagogical insights for science educators and curriculum developers. The findings suggest that the combination of inquiry-based learning and gamification not only supports academic achievement but also enhances students' emotional engagement and satisfaction. These dual benefits are particularly relevant for middle school learners, who often require active and varied instructional strategies to maintain focus and interest. Incorporating elements such as games, collaborative exploration, and student autonomy could become key design principles for future science learning interventions. Additionally, user-friendly teaching materials and supportive classroom atmospheres can further improve the overall learning experience.

Limitations

Despite the promising outcomes, this study is subject to several limitations. It was conducted with a relatively small sample size of 39 students from a single school, which restricts the generalizability of the results. The use of a post-test only design did not capture the progression or initial competencies of students. Furthermore, while qualitative feedback was collected, it was not analyzed using systematic coding methods, which may have limited the depth of interpretation regarding students' satisfaction and engagement.

Suggestions

Future research should consider employing a pre-test and post-test experimental design to better assess learning gains and cognitive development. Expanding the study to include multiple schools and diverse student populations would enhance the external validity of the findings. Additionally, researchers may investigate which specific gamification elements (e.g., badges, levels, leaderboards) most effectively complement inquiry-based learning. Exploring the long-term effects of such approaches on student retention, scientific literacy, and attitudes toward STEM subjects could also provide deeper insights into their educational impact.

CONCLUSION

This study investigates the academic performance of grade 7 students in thermal energy science, using inquiry-based learning with gamification, to a score of 70%. It also examines student satisfaction with this learning method. They had academic achievement higher than the 70% criterion at the .05 level of statistical significance, and they liked the learning organization. In conclusion, gamification in inquiry-based learning has the potential to inspire scientific learning. Suitability for the classroom context underscores the importance of designing materials that align with students' academic levels and cultural backgrounds. Contextualized materials increase relevance, making it easier for students to connect theoretical knowledge with real-life applications. However, the study requires more study about their learning behaviors and retention in other variables.

AUTHOR CONTRIBUTIONS STATEMENT

PK contributed to the conceptualization, development of lesson plans, data collection, and initial drafting of the manuscript. PN contributed to the supervision, validation of research methodology, and critical review of the manuscript. AS contributed to the refinement of analysis, academic editing, and final proofreading. All authors have read and agreed to the published version of the manuscript.

REFERENCES

Aidoo, B., Chebure, A., Gyampoh, A. O., Tsyawo, J., & Quansah, F. (2024). Assessing Student Teachers' Motivation and Learning Strategies in Digital Inquiry-Based Learning. *Education Sciences*, *14*(11), Article 11. https://doi.org/10.3390/educsci14111233

AlAfnan, M. A. (2025). Enhancing educational outcomes using AlAfnan taxonomy: Integrating cognitive, affective, and psychomotor domains. *International Journal of Evaluation and Research in Education (IJERE)*, *14*(3), Article 3. https://doi.org/10.11591/ijere.v14i3.33147

Ateş, H., & Polat, M. (2025). Leveraging augmented reality and gamification for enhanced self-regulation in science education. *Education and Information Technologies*. https://doi.org/10.1007/s10639-025-13481-0

Bantaokul, P., & Polyiem, T. (2022). The Use of Integrated 5Es of Inquiring-Based Learning and Gamification to Improve Grade 8 Student Science Learning Achievement. *Journal of Educational Issues*, *8*(1), 459–469. https://doi.org/10.5296/jei.v8i1.19802

Bybee, R. W. (2002). *Learning Science and the Science of Learning: Science Educators' Essay Collection*. NSTA Press. https://doi.org/10.2505/9780873552080

Chen, C.-H., & Chu, Y.-R. (2024). VR-assisted inquiry-based learning to promote students' science learning achievements, sense of presence, and global perspectives. *Education and Information Technologies*, *29*(15), 19421–19441. https://doi.org/10.1007/s10639-024-12620-3

Chengere, A. M., Bono, B. D., Zinabu, S. A., & Jilo, K. W. (2025). Enhancing secondary school students' science process skills through guided inquiry-based laboratory activities in biology. *PLOS ONE*, *20*(4), e0320692. https://doi.org/10.1371/journal.pone.0320692

Chu, S. K. W., Reynolds, R. B., Tavares, N. J., Notari, M., & Lee, C. W. Y. (2017). *21st Century Skills Development Through Inquiry-Based Learning*. Springer. https://doi.org/10.1007/978-981-10-2481-8

Conde-Izquierdo, S., Ruano, Á. M., & Nicolás, D. P. (2025). The impact of active methodologies in the classroom on academic achievement: A systematic literature review using the PRISMA protocol. *International Journal of Educational Research*, *132*, 102644. https://doi.org/10.1016/j.ijer.2025.102644

Constantinou, C. P., Tsivitanidou, O. E., & Rybska, E. (2018). What Is Inquiry-Based Science Teaching and Learning? In O. E. Tsivitanidou, P. Gray, E. Rybska, L. Louca, & C. P. Constantinou (Eds.), *Professional Development for Inquiry-Based Science Teaching and Learning* (pp. 1–23). Springer International Publishing. https://doi.org/10.1007/978-3-319-91406-0_1

DiCesare, D., Scheveck, B., Adams, J., Tassone, M., Diaz-Cruz, V. I., Van Dillen, C., Ganti, L., Gue, S., & Walker, A. (2025). The pit crew card game: A novel gamification exercise to improve EMS performance in critical care scenarios. *International Journal of Emergency Medicine*, *18*, 25. https://doi.org/10.1186/s12245-024-00748-5

Elsawah, W. (2025). Exploring the effectiveness of gamification in adult education: A learner-centric qualitative case study in a dubai training context. *International Journal of Educational Research Open*, *9*, 100465. https://doi.org/10.1016/j.ijedro.2025.100465

Fang, A. L. S. (2022). Effectiveness of a Gamification Tool for Classroom Management in Education Setting. *Higher Education and Oriental Studies*, *2*(5), Article 5. https://doi.org/10.54435/heos.v2i5.77

Fathi Najafi, T., Andaroon, N., Bolghanabadi, N., Sharifi, N., & Dashti, S. (2025). Gamification in midwifery education: A systematic review. *BMC Medical Education*, *25*(1), 297. https://doi.org/10.1186/s12909-025-06880-x

Ferreira, D. M., Sentanin, F. C., Parra, K. N., Negrao Bonini, V. M., de Castro, M., & Kasseboehmer, A. C. (2022). Implementation of Inquiry-Based Science in the Classroom and Its Repercussion on the Motivation to Learn Chemistry. *Journal of Chemical Education*, *99*(2), 578–591. https://doi.org/10.1021/acs.jchemed.1c00287

Fraisl, D., Hager, G., Bedessem, B., Gold, M., Hsing, P.-Y., Danielsen, F., Hitchcock, C. B., Hulbert, J. M., Piera, J., Spiers, H., Thiel, M., & Haklay, M. (2022). Citizen science in environmental and ecological sciences. *Nature Reviews Methods Primers*, *2*(1), 64. https://doi.org/10.1038/s43586-022-00144-4

Jong, M. S.-Y., Zhai, X., & Chen, W. (2024). Innovative Uses of Technologies in Science, Mathematics and STEM Education in K-12 Contexts. *International Journal of Science and Mathematics Education*, *22*(1), 1–9. https://doi.org/10.1007/s10763-024-10530-x

Joseph Anthony Nietes, Reanne Joy Aliligay, Rene Ellen Benneth Villacarlos, Reychel Mae Galindo, Ruthell Moreno, Via Dianne Fieldad, & Vivian Caspe. (2024). Effectiveness of Gamification Strategy in Increasing the Grade 10 Student’s Academic Motivation. *Psychology and Education: A Multidisciplinary Journal*, *17*(3), 1–1.

Kalogiannakis, M., Papadakis, S., & Zourmpakis, A.-I. (2021). Gamification in Science Education. A Systematic Review of the Literature. *Education Sciences*, *11*(1), Article 1. https://doi.org/10.3390/educsci11010022

Lu, M. (2024). *Navigating the Future of Information Science Education: Challenges, Innovations, and Emerging Trends*. 55–62. https://doi.org/10.2991/978-2-38476-277-4_8

Macgilchrist, F., Allert ,Heidrun, & and Bruch, A. (2020). Students and society in the 2020s. Three future 'histories' of education and technology. *Learning, Media and Technology*, *45*(1), 76–89. https://doi.org/10.1080/17439884.2019.1656235

Nzomo, C. M., Rugano, P., & Njoroge, J. M. (2023). Relationship between inquiry-based learning and students' attitudes towards chemistry. *International Journal of Evaluation and Research in Education (IJERE)*, *12*(2), 991. https://doi.org/10.11591/ijere.v12i2.24165

Ortiz-Rojas, M., Chiluiza, K., Valcke, M., & Bolanos-Mendoza, C. (2025). How gamification boosts learning in STEM higher education: A mixed methods study. *International Journal of STEM Education*, *12*(1). Scopus. https://doi.org/10.1186/s40594-024-00521-3

Özcan, C., & and Gücüm, B. (2025). Reading Comprehension Skills in Science: The Effect of Model-Based Approach Supported by Parent Education Level, Home Environment and Reading Texts. *Reading Psychology*, *46*(6), 583–605. https://doi.org/10.1080/02702711.2025.2482621

Papadakis, S., Zourmpakis, A.-I., & Kalogiannakis, M. (2023). Analyzing the Impact of a Gamification Approach on Primary Students' Motivation and Learning in Science Education. In M. E. Auer, W. Pachatz, & T. Rüütmann (Eds.), *Learning in the Age of Digital and Green Transition* (pp. 701–711). Springer International Publishing. https://doi.org/10.1007/978-3-031-26876-2_66

Prachagool, V., & Nuangchalerm, P. (2019). Investigating the Nature Of Science: An Empirical Report on the Teacher Development Program in Thailand. *Jurnal Pendidikan IPA Indonesia*, *8*(1), Article 1. https://doi.org/10.15294/jpii.v8i1.17275

Prachagool, V., & Nuangchalerm, P. (2021). Perspectives of Thai Educators toward 21st Century Instruction. *Journal of Education and Learning (EduLearn)*, *15*(3), 432–437. https://doi.org/10.11591/edulearn.v15i3.20281

Prayitno, B. A., Corebima, D., Susilo, H., Zubaidah, S., & Ramli, M. (2017). Closing The Science Process Skills Gap Between Students With High And Low Level Academic Achievement. *Journal of Baltic Science Education*, *16*(2), Continuous. https://doi.org/10.33225/jbse/17.16.266

Safkolam, R., Madahae, S., & Saleah, P. (2024). The Effects of Inquiry-based Learning Activities to Understand the Nature of Science of Science Student Teachers. *International Journal of Instruction*, *17*(1), Article 1. https://doi.org/10.29333/iji.2024.17125a

Sharma, P. K., S, H. K., & Verma, M. (2023). The Psychological Influence of Inquiry-Based Learning on Students' Emotional Intelligence and Well-Being in Education. *Journal for ReAttach Therapy and Developmental Diversities*, *6*(7s), Article 7s.

Sullivan, P. (2020). *Leading improvement in mathematics teaching and learning*. ACER Press.

Teke, B., & Çalışıcı, H. (2025). Using inquiry-based learning approach in the teaching process of divisibility rules. *Asia Pacific Education Review*. https://doi.org/10.1007/s12564-025-10036-3

Zhang, F., Brynildsrud ,Hanne, Papavlasopoulou ,Sofia, Sharma ,Kshitij, & and Giannakos, M. (2025). Where inquiry-based science learning meets gamification: A design case of Experiverse. *Behaviour & Information Technology*, *44*(5), 1099–1121. https://doi.org/10.1080/0144929X.2024.2433058