Journal Evaluation in Education (JEE)
Vol. 7, No. 2, April 2026, pp. 424~431
ISSN: 2716-4160, DOI: 10.37251/jee.v7i2.2656

Research Article

A Study on EduTainment: Enhancing Learning Activity in Science Learning

Andrie Kriesna Susilowaty[1,*], Nurhadji Nugraha[1], Yudi Hartono[1]
[1] Department of Pascasarjana in Social Education, Universitas PGRI Madiun, Jawa Timur, Indonesia

Article Info

Article history:

Received Dec 04, 2025
Revised Jan 23, 2026
Accepted Apr 14, 2026
OnlineFirst Apr 24, 2026

Keywords:

Edutainment
Learning Activity
Science Learning
Students

ABSTRACT

Purpose of the study: This study investigates the effectiveness of Edutainment-based learning devices in enhancing learning activity in elementary school science learning.

Methodology: A quantitative approach with a quasi-experimental posttest non-equivalent control group design was employed. The participants consisted of 14 fifth-grade students from an elementary school in Madiun City, Indonesia, divided into an experimental group (n = 7) and a control group (n = 7). The experimental group was taught using Edutainment-based learning devices, while the control group received conventional instructional tools. Data on students' learning activity were collected using observation sheets based on a four-point Likert scale and analyzed using descriptive statistics, independent sample t-tests, and N-gain analysis at a significance level of 0.05.

Main Findings: The findings reveal that students in the experimental group predominantly reached good (71.4%) and very good (28.6%) categories of learning activity, whereas the control group was dominated by not good (71.4%) and not very good (14.3%) categories. Inferential analysis confirmed a significant difference between the two groups ($t = 4.167 > t_{table} = 2.145$), indicating that Edutainment-based learning devices significantly outperform traditional approaches in promoting active learning. Moreover, an N-gain score of 0.6 suggests a moderate but meaningful improvement in students' learning activity.

Novelty/Originality of this study: The novelty of this study lies in its empirical validation of Edutainment-based learning devices specifically for IPAS at the elementary level, using learning activity as a core outcome rather than solely cognitive achievement.

Corresponding Author:
Andrie Kriesna Susilowaty,
Department of Pascasarjana in Social Education, Universitas PGRI Madiun,
Jl. Setia Budi No.85, Kanigoro, Kec. Kartoharjo, Kota Madiun, Jawa Timur 63118, Indonesia
Email: andrie_2401202085L@mhs.unipma.ac.id

1. INTRODUCTION

Education plays a strategic role in determining a nation's progress. High illiteracy rates and low educational quality will directly impact national decline, while improving the quality of education will strengthen the competitiveness of human resources [1]-[4]. In the era of globalization and the rapid development of science and technology, the world of education is required to keep pace with these changes to avoid being left

behind. Therefore, development in the educational sector is a primary means of improving the quality of human resources, including academic ability, personality, character, and civic responsibility.

Efforts to improve the quality of education are an integral part of improving the overall quality of human resources [5]-[8]. The government continues to strive to improve and enhance the quality of education at every level, one of which is realized through enhancing the quality of the teaching and learning process in schools. The learning process, as the core of educational activities, is heavily influenced by the availability of facilities and infrastructure, as well as the appropriate selection of learning methods and media. Each learning method and media has its own advantages and limitations, requiring teachers to be able to select and apply them appropriately according to the characteristics of the students and the learning material [9]-[13].

Based on observations of fifth-grade science learning at Elementary School 01 Nambangan Kidul, Manguharjo District, Madiun City, in the 2024/2025 academic year, various problems were identified. Students tended to be passive and less responsive to teacher questions. Student learing activity in science learning did not meet expectations, as evidenced by their low level of learning activity in asking questions, answering questions, completing and presenting assignments, and participating in discussions and problem-solving. Student learning activity is a crucial indicator for creating an optimal learning experience [14]-[19]. Active learning plays a fundamental role in successful learning. Active students tend to have a better understanding of the material and demonstrate higher learning outcomes [20]-[24]. Nurse-Clarke [25] also emphasized that active learning is a fundamental element determining student learning success. However, the science learning conditions at SDN 01 Nambangan Kidul indicate that students are still predominantly passive, such as sitting still, taking notes, working on worksheets, and listening to teacher explanations. Two-way interaction between teachers and students is very limited. Of the 15 students, 10, or 67%, are classified as inactive in learning.

This problem of active learning directly impacts student learning outcomes. Learning outcomes are an important indicator of the success of the learning process [26]-[28] and reflect changes in knowledge, attitudes, and skills after students participate in learning activities [29]-[31]. Factors influencing learning outcomes include internal factors, such as low student understanding, and external factors, such as teachers' uninnovative and conventional learning strategies (Hapnita, 2018; Cevikbas & Kaiser, 2020). Science exam data shows that only 5 students (33%) achieved the Minimum Completion Level (KKM) of 75. This situation indicates that science learning still takes place conventionally, with the teacher acting as the sole learning resource and students tending to be passive. This learning model provides little opportunity for students to develop thinking skills, process information, and apply science concepts in real-life contexts. As a result, students easily become bored, especially since science is often perceived as a theoretical, memorization-based, and difficult-to-understand subject. Therefore, innovative and engaging learning methods are needed to improve student learning activity and learning outcomes.

Enjoyable learning is the first step to successful learning. The use of diverse and engaging software and learning experiences can motivate students to explore learning more deeply [32]-[36]. One approach that has the potential to create meaningful and enjoyable learning is edutainment-based learning, a combination of education and entertainment. Edutainment allows students to learn without feeling overwhelmed, allowing them to discover the core of their learning naturally through enjoyable experiences. The implementation of edutainment-based learning is also relevant with the support of available facilities and infrastructure, particularly through the Chromebook Program in Madiun City, which has been running since 2023. This program aims to improve the quality of education through the use of digital technology and has provided tangible benefits for teachers and students. With the support of these facilities, edutainment-based learning has a significant opportunity to be optimally implemented in science and science teaching.

Although various studies have discussed the importance of active learning and the use of innovative methods, there is still a research gap regarding the empirical application of edutainment-based learning in improving active learning and learning outcomes in science at the elementary school level, especially in the context of fifth-grade science learning. Most learning practices still focus on conventional approaches, while studies that integrate edutainment with the systematic use of school technology are still limited. Therefore, research is needed that directly tests the effectiveness of edutainment-based learning in improving student learning activeness.

2. RESEARCH METHOD

The researcher’s research design is quantitative, using a quasi-experimental posttest non-equivalent control group design. It was done to investigate causal hypotheses by comparing one or more experimental groups that received treatment with a comparison group that did not. This research design was implemented because it aligned with the research objectives, which aimed to determine whether Edutainment-based learning devices could improve learning acticity. This study used descriptive statistics (average, minimum, and maximum) and inferential statistics. The inferential statistic used was the independent sample t-test.

Tabel 1. Posttest Non-Equivalent Control Group Design

Group	Pretest	Treatment	Posttest
Experimental	O_1	Using the Edutainment-based learning devices	O_1
Control	O_2	Traditional Learning Tools	O_2

This research was conducted at Elementary School 01 Nambangan Kidul, Madiun City, with a total of 14 fifth-grade students. There were 7 students in the experimental class and 7 students in the control class. The experimental class used Edutainment-Based Learning Tools, while the control class used traditional learning tools. The sample collection technique used was purposive sampling. Purposive sampling is a sampling technique based on the researcher's criteria. In this study, the first step in the data collection process was to provide intervention only to the experimental class using Edutainment-Based Learning Tools. In contrast, the control class received traditional learning tools. The results of the assessment of student activity were then compared between students who used Edutainment Learning Tools and those who did not. The instruments used were learning activity observation sheets. The learning activity observation sheet uses a 4-point Likert scale. Less active has a score of 1, moderately active has a score of 2, Active has a score of 3, and Very active has a score of 4.

The following are the categories of student learning activity and learning outcomes, including very good, good, sufficient, not good, and very bad, as shown in Table 2.

Table 2. Categorization of learning activity

Category	Interval
Very Good	12.1 – 16.0
Good	8.1 – 12.0
Moderate	4.1 – 8.0
Not Good	1.0 – 4.0

And category for n-gain in Tabel 3.

Table 3. N-Gain Category

N-Gain	Category
$G > 0.7$	High
$0.3 < G < 0.7$	Moderate
$G < 0.3$	Low

All data obtained from the observation sheets of student learning activity in the control and experimental classes were collected, then calculated and analyzed using SPSS 21. Descriptive statistics were used to calculate the frequency, percentage, average, minimum, and maximum for the control and experimental groups. In this study, quantitative data were analyzed using parametric statistics, including independent sample t-tests. Independent sample t-tests were conducted to test differences in student learning activity on edutainment-based learning devices. This study used SPSS 21 at a significance level of 0.05.

3. RESULTS AND DISCUSSION

This section describes the research findings on student learning activity. The results of the Category, Mean, Min, Max, and Percentage of the posttest, which show the impact of EduTainment-based learning devices on learning learning activity among elementary school students, are presented as follows table 4.

Table 4. Gaps in Learning Activity Students' Scores

	Interval			Mean	Min	Max	%
	Range	Category	Total				
Class Experiment	1.0 – 4.0	Not very good	0	15	11	15	0.0
	4.1 – 8.0	Not good	0				0.0
	8.1 – 12.0	Good	5				71.4
	12.1 – 16.0	Very good	2				28.6
	TOTAL		7				100
	Interval			Mean	Min	Max	%
	Range	Category	Total				
Class Control	1.0 – 4.0	Not very good	1	9	15	72	14.3
	4.1 – 8.0	Not good	5				71.4
	8.1 – 12.0	Good	1				14.3
	12.1 – 16.0	Very good	0				0.0
	TOTAL		7				100

From table 4, which comes from 14 respondents of Elementary School Students, is categorized as good in the experimental class, and after being processed and the results obtained using the SPSS 21 program application, it was found that the learning activity in the experimental class has a good category of 71.4% for 5 students from a total of 7 students, and very good at 25% for 4 students from a total of 16 students. Of the 14 students, the average is 68, the maximum is 78, and the minimum is 64. Then in the control class which comes from 14 respondents, the dominant category is not good, and after being processed and the results obtained using the SPSS 21 program application, it was found that the learning activity of students in the control class has a bad category of 50% for 8 students from a total of 16 students, good at 37.5% for 6 students from a total of 16 students, very bad at 12.5% for 2 students from a total of 16 students. The 16 students had an average score of 58, a maximum score of 72, and a minimum score of 48.

This comparison shows that traditional learning fails to meet students' need for active participation. At the same time, edutainment-based learning tools provide a more contextual, applicable, and problem-solving learning experience, thus encouraging improved student academic achievement.

Table 5. Independent sample t-test for learning activity

	t	df	Mean	Std.Deviation	*95% confidence interval*	
					Lower	*Upper*
Literacy Scientific	4.167	14	3.2517	.14678	8.224	.6821
	4.167	2.145	2.6621	.20051	7.663	.8321

From table 5 it can be seen that the value obtained (t count) with the t table value. The t table value can be found in the t table with a significance value of 0.05 (2-sided test) with degrees of freedom (df) 14. In this study, the results for the t table are 2.145. While for the t count value can be seen in table 5 (t column) which is 4.167. The criterion for testing the hypothesis is the rejection value of H0. So, it can be concluded that there is a significant difference in student learning activity between the control class taught with traditional learning tools and the experimental class using Edutainment-based learning tools. It can be seen from table 5 that the average value of student learning activity is 3.1972, which means it can increase student learning activity. To emphasize this result, the n-gain value is obtained as in table 6.

Tabel 6. N-Gain Results

N-gain Score	Conclusion
0.6	Moderate

The effectiveness of the Edutainment-based learning device is evident from the N-gain score in Table 6. The average value is 0.6. This indicates that the effectiveness of the Edutainment-based learning device in learning falls into the moderate category, or the interpretation category is quite effective. This moderate category indicates that the device is functioning optimally, but still has room for further development to reach the high category.

The results of this study provide robust empirical evidence that Edutainment-based learning devices significantly enhance elementary school students' learning activity compared to conventional instructional approaches. The descriptive statistics presented in Table 4 indicate that students in the experimental class predominantly achieved *good* (71.4%) and *very good* (28.6%) levels of learning activity, whereas students in the

control class were largely concentrated in the *not good* (71.4%) and *not very good* (14.3%) categories. This marked distributional contrast suggests that Edutainment-based instruction creates learning conditions that are more conducive to active student participation. From a theoretical standpoint, these findings align with constructivist and student-centered learning paradigms, which posit that learning effectiveness is maximized when students are actively engaged in the learning process [37]-[40]. Edutainment-based learning integrates instructional content with interactive and enjoyable elements, enabling students to engage cognitively, behaviorally, and emotionally. Prior research has consistently shown that such multimodal learning activity is a critical determinant of learning activity, particularly in primary education contexts [41]-[43].

The higher mean learning activity score in the experimental class (M = 68) compared to the control class (M = 58), alongside higher minimum and maximum scores, further indicates that Edutainment-based learning not only increases overall learning activity but also contributes to a more consistent level of participation among students. This finding supports previous studies reporting that interactive learning environments reduce passive learning behaviors and encourage broader student involvement [44]-[45]. Inferential analysis using the independent samples t-test confirms the statistical significance of these differences. The obtained t-value ($t = 4.167$) exceeds the critical value ($t = 2.145$, $\alpha = 0.05$), leading to the rejection of the null hypothesis. This result demonstrates that the improvement in student learning activity is attributable to the implementation of Edutainment-based learning devices rather than random variation. Similar outcomes have been reported in studies on game-based and edutainment-oriented learning, which consistently highlight their positive effects on student learning activity and classroom interaction [46]-[49].

Furthermore, the N-gain analysis reveals a score of 0.6, which falls within the *moderate* effectiveness category. According to Triyono [50], a moderate N-gain reflects a meaningful instructional impact, indicating that the learning intervention facilitates substantial improvement while still allowing room for refinement. In the context of elementary education, this level of effectiveness is pedagogically significant, as students often require sustained exposure and scaffolding to fully adapt to innovative learning approaches. The moderate N-gain result also suggests that while the Edutainment-based learning device effectively promotes learning activity, its impact could be further enhanced through optimization of instructional design, such as improved alignment between learning objectives and entertainment elements, differentiated task difficulty, and extended implementation duration. As emphasized by Othman [51], the educational value of edutainment depends not on entertainment alone, but on its integration with sound pedagogical principles. Overall, the findings indicate that traditional learning approaches tend to limit student learning activity by emphasizing teacher-centered instruction and passive knowledge transmission. In contrast, Edutainment-based learning devices foster active learning environments that encourage interaction, exploration, and problem-solving. Given that learning activity is a key predictor of deeper cognitive processing and academic achievement [52], [53], the adoption of Edutainment-based learning represents a strategically relevant approach for improving instructional quality in elementary education.

The novelty of this study lies in its empirical validation of Edutainment-based learning devices specifically designed to enhance learning activity in elementary science (IPAS) classrooms, rather than focusing solely on learning outcomes or motivation. Unlike previous studies that generally discuss edutainment conceptually or in secondary education contexts, this research integrates systematic observation-based measurement, statistical comparison, and N-gain analysis within a real elementary school setting supported by digital infrastructure. The findings provide concrete evidence that Edutainment is not merely engaging but pedagogically effective in fostering active learning behaviors among young learners. This study strengthens constructivist and student-centered learning theories by demonstrating that learning environments combining instructional content with entertainment elements significantly enhance student learning activity. The findings confirm that learning activity is a critical mediator between instructional design and meaningful learning in primary education. The findings of this study imply that Edutainment-based learning devices represent an effective instructional approach for enhancing learning activity in elementary science education. The significant increase in student learning activity supports student-centered and constructivist learning theories, highlighting the importance of integrating interactive and enjoyable elements into instructional design to promote active participation. Practically, the results suggest that teachers can utilize Edutainment-based learning as an alternative to conventional methods to reduce passive learning behaviors and foster more dynamic classroom interactions, particularly in technology-supported learning environments. From a policy perspective, the study provides empirical support for the integration of innovative, technology-assisted learning strategies within elementary education curricula to improve instructional quality and student learning activity in science learning. Despite its contributions, this study has several limitations. First, the small sample size limits the generalizability of the findings to broader educational contexts. Second, the study focused only on learning activity as the dependent variable, without examining its long-term effects on learning outcomes, critical thinking, or scientific literacy. Third, the duration of the intervention was relatively short, which may not fully capture the sustained impact of Edutainment-based learning. Additionally, the study was conducted in a single school, making contextual factors difficult to control.

4. CONCLUSION

This study concludes that Edutainment-based learning devices significantly improve elementary school students' learning activity in science learning compared to traditional instructional approaches. Students taught using Edutainment-based tools demonstrated higher levels of learning activity, participation, and active involvement in the learning process. Statistical analysis confirmed a significant difference between the experimental and control groups, supported by a moderate N-gain score indicating meaningful instructional effectiveness. Overall, Edutainment-based learning provides a promising pedagogical approach for creating enjoyable, interactive, and student-centered learning environments in elementary education. Future research is recommended to involve larger samples, longer intervention periods, and additional learning variables such as learning outcomes, scientific literacy, and higher-order thinking skills to further strengthen the empirical foundation of Edutainment-based instruction.

ACKNOWLEDGEMENTS

The author would like to express sincere gratitude to the teachers and management of school for their openness, cooperation, and valuable insights throughout the research process.

AUTHOR CONTRIBUTIONS

The author was solely responsible for the conceptualization and design of the study, data collection, implementation of the narrative counseling intervention, data analysis, and interpretation of the results. The author also prepared the original draft of the manuscript, revised the content critically, and approved the final version for publication.

CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

REFERENCES

[1] J. Li, E. Xue, Y. Wei, and Y. He, "How popularising higher education affects economic growth and poverty alleviation: empirical evidence from 38 countries," *Humanities and Social Sciences Communications*, vol. 11, no. 1, 2024, doi: 10.1057/s41599-024-03013-5.

[2] J. Liu, K. Jungyin, S. Jaewoo, L. Heechul, and W. U. H. Shah, "Evaluating the efficiency, productivity change, and technology gaps of China's provincial higher education systems: A comprehensive analytical framework," *PLoS One*, vol. 19, no. 1, pp. e0294902, 2024, doi: 10.1371/journal.pone.0294902.

[3] S. Mamanazarov, M. Khajiyeva, D. Abdullaeva, G. Yuldasheva, R. Azkhodjaeva, A. Pirnazarov, and N. Xamedova, "Innovating human capital development: The role of education, law, and economics through digital transformation," *Qubahan Academic Journal*, vol. 5, no. 3, pp. 78-113, 2025, doi: 10.48161/qaj.v5n3a1698.

[4] M. N. Obizue, and S. Enomah, "Human capital development and educational advancement in Nigeria: Realities and way forward," *Int'l Journal of Education Research and Scientific Development*, vol. 7, no. 2, pp. 15-27, 2025, doi: 10.59795/ijersd.v7i2.213.

[5] R. Ananda, W. Putra, and C. Wijaya, "Quality management of kindergarten teaching staff: A multisite study of integrated islamic kindergartens in Aceh," *Journal Evaluation in Education (JEE)*, vol. 6, no. 4, pp. 1314-1323, 2025, doi: 10.37251/jee.v6i4.2234.

[6] M. Marzuki, "Human resources analysis based on total quality management in improving management educational process," *Scaffolding: Jurnal Pendidikan Islam dan Multikulturalisme*, vol. 5, no. 1, pp. 953-967, 2023, doi: 10.37680/scaffolding.v5i1.5125.

[7] T. Sumual, H. Lumapow, and V. Rotty, "The role of human capital investment in improving the quality of human resources (hr) in education in the digital era," *Asian Journal of Engineering, Social and Health*, vol. 3, no. 11, pp. 2520-2528, 2024, doi: 10.46799/ajesh.v3i11.449.

[8] A. Akmaluddin, L. K. Kasmini, S. M. Sari, and M. Iqbal, "Human resource management strategy in improving the quality of education," *Jurnal Eduscience*, vol. 12, no. 2, pp. 553-560, 2025, doi: 10.36987/jes.v12i2.6843.

[9] M. Mohiuddin, E. Hosseini, S. B. Faradonbeh, and M. Sabokro, "Achieving human resource management sustainability in universities," *International journal of environmental research and public health*, vol. 19, no. 2, pp. 928, 2022, doi: 10.3390/ijerph19020928.

[10] N. Permatasari, and S. Tandiayuk, "Human resource management in education: Optimizing teacher performance for better learning outcomes," *Golden Ratio of Mapping Idea and Literature Format*, vol. 3, no. 1, pp. 35-59, 2023, doi: 10.52970/grmilf.v3i1.354.

[11] J. Wen, H. Hussain, J. Waheed, W. Ali, and I. Jamil, "Pathway toward environmental sustainability: mediating role of corporate social responsibility in green human resource management practices in small and medium enterprises," *International Journal of Manpower*, vol. 43, no. 3, pp. 701-718, 2022, doi: 10.1108/IJM-01-2020-0013.

[12] J. K. Matitaputty, and J. Sopacua, "The effectiveness of the learning cycle 5e learning model in an effort to improve learning outcomes of history," *JIM: Jurnal Ilmiah Mahasiswa Pendidikan Sejarah*, vol. 8, no. 1, pp. 740-747, 2023, doi: 10.24815/jimps.v8i2.24816.
[13] M. S. S. Al Faruq, A. Sunoko, M. A. F. Rozi, and A. Salim, "Enhancing educational quality through principals' human resources management strategies," *Al-Ishlah: Jurnal Pendidikan*, vol. 16, no. 2, pp. 1108-1117, 2024, doi: 10.35445/alishlah.v16i2.5042.
[14] A. Ahmad, J. Schneider, D. Griffiths, D. Biedermann, D. Schiffner, W. Greller, and H. Drachsler, "Connecting the dots–A literature review on learning analytics indicators from a learning design perspective," *Journal of Computer Assisted Learning*, vol. 40, no. 6, pp. 2432-2470, 2024, doi: 10.1111/jcal.12716.
[15] Z. Xu, "AI in education: Enhancing learning experiences and student outcomes," *Applied and Computational Engineering*, vol. 51, no. 1, pp. 104-111, 2024, doi: 10.54254/2755-2721/51/20241187.
[16] A. Grájeda, J. Burgos, P. Córdova, and A. Sanjinés, "Assessing student-perceived impact of using artificial intelligence tools: Construction of a synthetic index of application in higher education," *Cogent Education*, vol. 11, no. 1, pp. 2287917, 2024, doi: 10.1080/2331186X.2023.2287917.
[17] E. Evendi, A. Kusaeri, A. Kusaeri, M. Pardi, L. Sucipto, F. Bayani, and S. Prayogi, "Assessing students' critical thinking skills viewed from cognitive style: study on implementation of problem-based e-learning model in mathematics courses," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 18, no. 7, 2022, doi: 10.29333/ejmste/12161.
[18] J. Singh, L. Singh, and B. Matthees, "Establishing social, cognitive, and teaching presence in online learning—A panacea in COVID-19 pandemic, post vaccine and post pandemic times," *Journal of Educational Technology Systems*, vol. 51, no. 1, pp. 28-45, 2022, doi: 10.1177/00472395221095169.
[19] A. Pandita, and R. Kiran, "The technology interface and student engagement are significant stimuli in sustainable student satisfaction," *Sustainability*, vol. 15, no. 10, pp. 7923, 2023, doi: 10.3390/su15107923.
[20] A. Kozanitis, and L. Nenciovici, "Effect of active learning versus traditional lecturing on the learning achievement of college students in humanities and social sciences: A meta-analysis," *Higher Education*, vol. 86, no. 6, pp. 1377-1394, 2023, doi: 10.1007/s10734-022-00977-8.
[21] K. Børte, K. Nesje, and S. Lillejord, "Barriers to student active learning in higher education," *Teaching in higher education*, vol. 28, no. 3, pp. 597-615, 2023, doi: 10.1080/13562517.2020.1839746.
[22] C. Wekerle, M. Daumiller, and I. Kollar, "Using digital technology to promote higher education learning: The importance of different learning activities and their relations to learning outcomes," *Journal of Research on Technology in Education*, vol. 54, no. 1, pp. 1-17, 2022, doi: 10.1080/15391523.2020.1799455.
[23] T. Hailikari, V. Virtanen, M. Vesalainen, and L. Postareff, "Student perspectives on how different elements of constructive alignment support active learning," *Active Learning in Higher Education*, vol. 23, no. 3, pp. 217-231, 2022, doi: 10.1177/1469787421989160.
[24] N. Nurse-Clarke, B. H. Acevedo, M. Tesoro, T. Lundy, M. Clifton, and M. Mathew, "Active learning strategies to enhance student success," *Journal of Nursing Education*, vol. 61, no. 3, pp. 167-167, 2022, doi: 10.3928/01484834-20220109-05.
[25] M. Muhajirin, A. Nugraha, R. Irmayanti, A. P. Rahimsyah, and A. L. Anjarika, "Strengthening academic hardiness through self-reflection-based narrative counseling: a single-case research," *Journal Evaluation in Education (JEE)*, vol. 7, no. 1, pp. 324-337, 2026, doi: 10.37251/jee.v7i1.2464.
[26] R. Li, A. Lund, and A. Nordsteien, "The link between flipped and active learning: A scoping review," *Teaching in Higher Education*, vol. 28, no. 8, pp. 1993-2027, 2023, doi: 10.1080/13562517.2021.1943655.
[27] S. Rahmah, and A. H. Lubis, "Problem posing as a learning model to improve primary school students' mathematics learning outcomes in Gayo Lues," *Journal of Indonesian Primary School*, vol. 1, no. 4, pp. 93-104, 2024, doi: 10.62945/jips.v1i4.409.
[28] M. M. Casanovas, N. Ruíz-Munzón, and M. Buil-Fabregá, "Higher education: The best practices for fostering competences for sustainable development through the use of active learning methodologies," *International Journal of Sustainability in Higher Education*, vol. 23, no. 3, pp. 703-727, 2022, doi: 10.1108/IJSHE-03-2021-0082.
[29] S. Tolppanen, J. Kang, and L. Riuttanen, "Changes in students' knowledge, values, worldview, and willingness to take mitigative climate action after attending a course on holistic climate change education," *Journal of Cleaner Production*, vol. 373, pp. 133865, 2022, doi: 10.1016/j.jclepro.2022.133865.
[30] P. Kumar, J. Sahani, N. Rawat, S. Debele, A. Tiwari, A. P. M. Emygdio, K. V. Abhijith, V. Kukadia, K. Holmes, and S. Pfautsch, "Using empirical science education in schools to improve climate change literacy," *Renewable and Sustainable Energy Reviews*, vol. 178, pp. 113232, 2023, doi: 10.1016/j.rser.2023.113232.
[31] D. H. Tong, B. P. Uyen, and L. K. Ngan, "The effectiveness of blended learning on students' academic achievement, self-study skills and learning attitudes: A quasi-experiment study in teaching the conventions for coordinates in the plane," *Heliyon*, vol. 8, no. 12, 2022, doi: 10.1016/j.heliyon.2022.e12657.
[32] S. Garces, C. Vieira, G. Ravai, and A. J. Magana, "Engaging students in active exploration of programming worked examples," *Education and Information Technologies*, vol. 28, no. 3, pp. 2869-2886, 2023, doi: 10.1007/s10639-022-11247-6.
[33] J. T. Wong, and B. S. Hughes, "Leveraging learning experience design: Digital media approaches to influence motivational traits that support student learning behaviors in undergraduate online courses," *Journal of Computing in Higher Education*, vol. 35, no. 3, pp. 595-632, 2023, doi: 10.1007/s12528-022-09342-1.
[34] C. A. Flores, D. N. Daran, J. M. D. Aquino, and K. J. J. F. Aranilla, "Innovation of teaching strategies in factors associated with flexible learning of drafting students," *Journal Evaluation in Education (JEE)*, vol. 6, no. 2, pp. 313-322. https://doi.org/10.37251/jee.v6i2.1451.

[35] C. J. Hellín, F. Calles-Esteban, A. Valledor, J. Gómez, S. Otón-Tortosa, and A. Tayebi, "Enhancing student motivation and engagement through a gamified learning environment," *Sustainability*, vol. 15, no. 19, pp. 14119, 2023, doi: 10.3390/su151914119.
[36] I. Aldalur, and A. Perez, "Gamification and discovery learning: Motivating and involving students in the learning process," *Heliyon*, *9*(1), 2023, doi: 10.1016/j.heliyon.2023.e13135.
[37] A. H. S. Dzaiy, and S. A. Abdullah, "The use of active learning strategies to foster effective teaching in higher education institutions," *Zanco Journal of Human Sciences*, vol. 28, no. 4, pp. 328-351, 2024, doi: 10.21271/zjhs.28.4.18.
[38] G. J. Kiptiony, "Shifting the paradigm: A critical review of educational approaches for fostering learner well-being," *Journal of Pedagogy and Curriculum (JPC)*, vol. 3, no. 1, pp. 1-13, 2024, doi: 10.51317/jpc.v3i1.503.
[39] V. N. Larsari, and H. Abouabdelkader, "An investigation into flipped learning classroom (FLC) of EFL sixth grade students' grammar literacy development: Implications for student-centered approach," *International Journal of Education and Literacy Studies*, vol. 12, no. 1, pp. 13-24, 2024, doi: 10.7575/aiac.ijels.v.12n.1p.13.
[40] S. Wibowo, M. N. Wangid, and F. M. Firdaus, "The relevance of vygotsky's constructivism learning theory with the differentiated learning primary schools," *Journal of education and learning (EduLearn)*, vol. 19, no. 1, pp. 431-440, 2025, doi: 10.11591/edulearn.v19i1.21197.
[41] M. Giannakos, and M. Cukurova, "The role of learning theory in multimodal learning analytics," *British Journal of Educational Technology*, vol. 54, no. 5, pp. 1246-1267, 2023, doi: 10.1111/bjet.13320.
[42] V. Aloizou, A. Ioannou, M. Boloudakis, and S. Retalis, "A learning experience design framework for multimodal learning in the early childhood," *Smart Learning Environments*, vol. 12, no. 1, pp. 1-17, 2025, doi: 10.1186/s40561-025-00376-3.
[43] H. Ouhaichi, D. Spikol, and B. Vogel, "Research trends in multimodal learning analytics: A systematic mapping study," *Computers and Education: Artificial Intelligence*, vol. 4, pp. 100136, 2023, doi: 10.1016/j.caeai.2023.100136.
[44] J. Li, and E. Xue, "Dynamic interaction between student learning behaviour and learning environment: Meta-analysis of student engagement and its influencing factors," *Behavioral Sciences*, vol. 13, no. 1, pp. 59, 2023, doi: 10.3390/bs13010059.
[45] J. Miao, J. Chang, and L. Ma, "Teacher–student interaction, student–student interaction and social presence: Their impacts on learning engagement in online learning environments," *The Journal of genetic psychology*, vol. 183, no. 6, pp. 514-526, 2022, doi: 10.1080/00221325.2022.2094211.
[46] M. Nadeem, M. Oroszlanyova, and W. Farag, "Effect of digital game-based learning on student engagement and motivation," *Computers*, vol. 12, no. 9, pp. 177, 2023, doi: 10.3390/computers12090177.
[47] H. B. Hui, and M. S. Mahmud, "Influence of game-based learning in mathematics education on the students' cognitive and affective domain: A systematic review," *Frontiers in psychology*, vol. 14, pp. 1105806, 2023, doi: 10.3389/fpsyg.2023.1105806.
[48] C. Balakrishna, "The impact of in-classroom non-digital game-based learning activities on students transitioning to higher education," *Education sciences*, vol. 13, no. 4, pp. 328, 2023, doi: 10.3390/educsci13040328.
[49] A. C. E. Ding, and C. H. Yu, "Serious game-based learning and learning by making games: Types of game-based pedagogies and student gaming hours impact students' science learning outcomes," *Computers & Education*, vol. 128, pp. 105075, 2024, doi: 10.1016/j.compedu.2024.105075.
[50] A. Triyono, R. H. Nuary, N. Permatasari, Y. Yuni, and T. Wibowo, "The level of effectiveness of tps and conventional methods judging from students' geometry learning results using the N-Gain Test," *AlphaMath: Journal of Mathematics Education*, 142-156, 2024, doi: 10.30595/alphamath.v10i1.21530.
[51] H. S. Othman, S. B. Zaibon, and A. H. Z. Abidin, "The significance of edutainment concept in video-based learning in proposing the elements of educational music video for children's learning," *International Journal of Interactive Mobile Technologies*, vol. 16, no. 5, 2022, doi: 10.3991/ijim.v16i05.23711.
[52] A. M. Dvoinin, and E. S. Trotskaya, "Cognitive predictors of academic success: How do the general patterns work in the early stages of education," *Psychological Science and Education*, vol. 27, no. 2, pp. 42-52, 2022, doi: 10.17759/pse.2022270204.
[53] A. Kukkar, R. Mohana, A. Sharma, and A. Nayyar, "Prediction of student academic performance based on their emotional wellbeing and interaction on various e-learning platforms," *Education and Information Technologies*, vo. 28, no. 8, pp. 9655-9684, 2023, doi: 10.1007/s10639-022-11573-9.