Interval: Indonesian Journal of Mathematical Education
Vol. 2, No. 2, December 2024, pp. 141~148
ISSN: 3021-7857, DOI: 10.37251/ijome.v2i2.1355

The Influence of PBL Model Based on Ethnomathematics on Critical Thinking Skills Reviewed from the Character of Love for the Country in Junior High Schools

Guido David[1], Yusnidar[2], Roussanka Loukanova[3], David Csaba Kertesz[4], Raj Kumar Koirala[5]
[1] Institute of Mathematics, University of the Philippines Diliman, Quezon City, Philippines
[2] Faculty of Teacher Training and Education, University of Jambi, Indonesia
[3] Institute of Mathematics and Informatics (IMI) Bulgarian Academy of Sciences (BAS), Bulgaria
[4] University of Debrecen, Institute of Mathematics, H-4010 Debrecen, P.O. Box 12, Hungary
[5] Institute of Forestry, Tribhuvan University, Pokhara, Nepal

Article Info

Article history:

Received Sep 17, 2024
Revised Oct 5, 2024
Accepted Nov 13, 2024
Online First Dec 12, 2024

Keywords:

21st Century Education
Ethnomathematics
Problem-Based Learning (PBL)
Thinking Skills

ABSTRACT

Purpose of the study: This study aims to analyze the effect of the Problem-Based Learning (PBL) model integrated with ethnomathematics on students' critical thinking skills, considering the mediating role of curiosity.

Methodology: This study uses a quantitative approach using Structural Equation Modeling-Partial Least Squares (SEM-PLS) to evaluate the relationship between variables. Indicators for the PBL model include understanding of ethnomathematics concepts, cultural relevance, student engagement, and effectiveness in learning. Critical thinking skills are assessed through basic clarification, inference, and strategy, while curiosity is measured by attention, questioning, and comparison.

Main Findings: The results showed that the ethnomathematics-based PBL model significantly improved students' critical thinking skills, with a direct effect of 0.68 and a total effect of 0.92 when mediated by curiosity (indirect effect 0.24). This model explains 62% of the variance in critical thinking skills and 29% in curiosity. This study introduces a novel integration of cultural context into a PBL framework, showing that embedding local traditions enhances cognitive engagement and critical thinking in a meaningful way.

Novelty/Originality of this study: The findings suggest that incorporating ethnomathematics into PBL not only enhances cognitive skills but also fosters curiosity, offering an effective and culturally responsive teaching strategy.

Corresponding Author:
Yusnidar
Faculty of Teacher Training and Education, Universitas Jambi.
Jl. Jambi-Muara Bulian Km. 15, Mendalo Darat, Kecamatan Jambi Luar Kota, Kabupaten Muarojambi, Jambi (36122), Indonesia.
Email: yusnidar@unja.ac.id

1. INTRODUCTION

Mathematics learning is often considered challenging by students because it is seen as an abstract and theoretical discipline. However, an approach that connects mathematics with local culture, such as ethnomathematics, can make learning more interesting and relevant [1]-[3]. Ethnomathematics is a branch of science that connects mathematics with the culture of local communities [4]-[6]. This approach reveals how local traditions, games, arts, or activities contain mathematical elements that can be recognized, understood, and applied [7]-[9]. By exploring cultural elements, ethnomathematics can be a bridge between traditional and modern knowledge.

Mathematics is often considered an abstract discipline, but it can be integrated with culture to enrich students' learning experiences. The concept of ethnomathematics utilizes local culture to explain mathematical concepts, such as the congklak/sungka game in Indonesia and the Philippines [10]-[12]. Through the ethnomathematics-based PBL approach, students are invited to solve real problems taken from these traditional games [13]-[15]. This approach not only improves students' creative thinking skills but also instills a sense of pride in cultural heritage and builds a character of love for the homeland.

In Indonesia, ethnomathematics has become an important concern in education. The diverse cultural richness of the archipelago provides ample opportunities to integrate cultural elements into mathematics learning [16]-[18]. For example, traditional games as widely known in society are congklak games or also called sungka. The application of ethnomathematics not only preserves local culture, but also increases students' interest and understanding of mathematical concepts.

Meanwhile, in the Philippines, ethnomathematics has also received attention through the exploration of local culture, one of which is the traditional game Sungka [19], [20]. This game reflects the local wisdom of the Filipino people which contains strategic and mathematical values [7], [21]. Sungka, known as the mancala game in various other cultures, shows how cultural and mathematical elements can synergize to produce meaningful learning.

The Sungka game itself is a traditional Filipino game played on a perforated board with seeds or shells as game tools. Traditional games such as congklak and sungka are cultural heritages that are rich in educational value, including mathematical concepts [3], [11]. In the context of education, the integration of these traditional games through the PBL model based on ethnomathematics provides an opportunity to develop students' creative thinking skills while instilling values of love for the homeland [22]-[24]. Thus, mathematics learning becomes more relevant, interesting, and meaningful, and is able to prepare students to face global challenges without forgetting their cultural roots [4], [25], [26].

Integrating traditional games such as Sungka in mathematics learning also has the potential to improve students' creative thinking skills. Creative thinking skills are very important in 21st century learning because they help students face challenges with innovative solutions [27]-[29]. This game encourages students to solve problems independently, develop strategies, and adapt to dynamic game situations [11], [30], [31].

Based on previous research, the use of ethnomathematics through traditional games such as Sungka in mathematics learning is still rarely done [32]. One of the main reasons is the lack of teacher understanding of how to integrate traditional games into the curriculum [33]-[35]. In fact, this approach can be an interesting solution to improve learning methods that tend to be monotonous [36], [37]. By conducting further research, this implementation can have a positive impact on mathematics learning.

The novelty of this approach lies in the combination of local culture and learning creative thinking skills. Research on the integration of traditional games such as Sungka in mathematics learning provides a new perspective that has not been widely studied in various countries. This opens up opportunities to utilize cultural heritage as an innovative learning medium that is relevant to the needs of today's students [3], [38], [39].

Through this research, it is hoped that an effective approach can be found in integrating traditional games into the mathematics learning curriculum. In this way, students not only gain a deeper understanding of mathematics, but are also inspired to appreciate local culture as part of their identity. This effort is in line with the vision of education in the modern era which emphasizes the balance between mastery of science and preservation of cultural heritage.

2. RESEARCH METHOD

This study uses a quantitative research design with an associative research type. Associative research compares two groups of students and connects the independent variable with the dependent variable [40]-[42]. With this research design, it is suitable to analyze the effect of ethnomathematics-based problem-based learning (PBL) models and patriotism characters on students' creative thinking skills.

The research population was grade VII students in junior high schools located in Indonesia and the Philippines. The research sample was 100 students, consisting of 50 students from one SMP in Indonesia and 50 students from one SMP in the Philippines. The sample selection was carried out using a purposive sampling technique based on certain criteria that were relevant to the research objectives [43], [44]. The sampling technique was based on certain considerations, such as location, curriculum, and student experience with the ethnomathematics-based PBL method.

The instruments used include response questionnaire of the application of learning models to measure ethnomathematics-based PBL models. The indicators that will be measured in the ethnomathematics-based PBL model are: Understanding of Ethnomathematics Concepts, Cultural Relevance in Learning, Student Involvement and Participation, Effectiveness of the PBL Learning Model, Impact on Skills and Attitudes [13]. Furthermore essay test to assess students' creative thinking skills. The following is a grid of essay questions in table 1.

Table 1. Grid of Critical Thinking Essay Test Questions

No	indicator	Question Item
1	Namely elementary clarification	1,2
2	Basic support	3,4
3	Inference	5,6
4	Advance clarification	7,8
5	Strategy and tactics	9,10

Source: Ennis [46]

Next, the questionnaire response instrument used to measure the character of curiosity, the questionnaire response grid can be seen in table 2 below.

Table 2. curiosity character response questionnaire grid

No	indicator	Measurement Items	Question Item
1	Pay attention	- Students pay attention when the teacher explains the material - Students pay attention to other students who express opinions in group discussions - Students pay attention to other students who make presentations in front of the class - Students pay attention to each assignment given from the teacher	1,2
2	Take notes	- Students record any material given by the teacher - Students record any new information they get from friends - Students have complete notebooks on the subject matter - Students record information from the school noticeboard	3,4
3	Asking	- Students show an effort to understand the subject matter by asking the teacher - Students ask questions when discovering new terms from media (print, electronic and social) - Students ask questions for each group discussion activity - The student asks other students if they hear something they have not known before	5,6
4	Comparing	- Students compare the new information obtained with previously known information - Students use various sources (books etc.) to understand the subject matter - Students compare teachers' opinions with other teachers about a topic - Students compare students' opinions with other students about a topic	7,8

Source: Herwin & Nurhayati [47]

Data analysis techniques in quantitative research are using statistics. In this study, data analysis used descriptive statistics and inferential statistics and saw the relationship between variables using SEM-PLS. The data in this study were analyzed using inferential statistics with multiple linear regression methods. Before conducting the hypothesis test, an assumption test was conducted to ensure that the data met the analysis requirements. The assumption test includes a normality test to check whether the data is normally distributed, a multicollinearity test to ensure that there is no very strong linear relationship between independent variables, and a heteroscedasticity test to verify that the residual variance is homogeneous [48]-[50]. After all assumptions are met, a hypothesis test was conducted to test the simultaneous and partial effects of the independent variables, namely the PBL learning model based on ethnomathematics and the character of patriotism, on the dependent variable, namely students' creative thinking skills.

3. RESULTS AND DISCUSSION

The relationship between the variables of the etnomathematical-based PBL model, critical thinking skills and curiosity character will be displayed with the path coefficients obtained from the PLS-SEM analysis which can be seen in Figure 1 below.

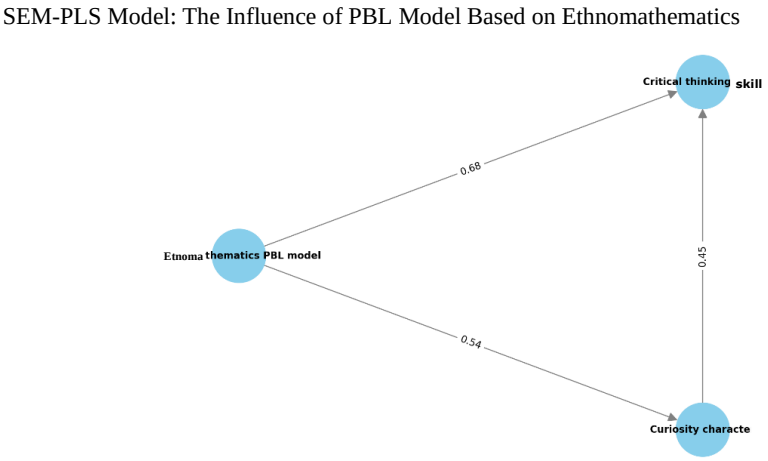

Figure 1. SEM-PLS Results

The analysis results of Figure 1. show a strong direct effect of the ethnomathematics PBL model on critical thinking skills (0.68), indicating its significant role in improving students' analytical abilities. In addition, this model highlights a moderate relationship between the ethnomathematics PBL model and the development of curiosity character (0.54). In addition, the curiosity character itself has a significant effect on critical thinking skills (0.45), indicating its mediating role in this relationship. The results of the validity and reliability of each indicator of the ethnomathematical-based PBL model, critical thinking skills and curiosity character can be seen in table 3 below:

Table 3. Outer Model (Validity and Reliability of Indicators)

Latent Variables	Indicators	Loading Factor	Information
PBL Model of Ethnomathematics (X)	Understanding of Ethnomathematics Concepts	0.78	Valid
	Cultural Relevance in Learning	0.82	Valid
	Student Involvement and Participation	0.85	Valid
	Effectiveness of the PBL Learning Model	0.80	Valid
	Impact on Skills and Attitudes	0.79	Valid
Critical Thinking Skills (Y1)	Elementary Clarification	0.76	Valid
	Basic Support	0.80	Valid
	Inference	0.84	Valid
	Advance Clarification	0.78	Valid
	Strategy and Tactics	0.82	Valid
Character of Curiosity (Y2)	Pay Attention	0.81	Valid
	Take Notes	0.79	Valid
	Asking	0.85	Valid
	Comparing	0.83	Valid

Based on the results of table 3 above, the Loading factor > 0.70 shows that all indicators are valid for representing their respective latent variables.

Tabel 4. Inner Model (Hubungan Antar Variabel)

Relationship Between Variables	Path Coefficient	Description
PBL Model → Critical Thinking Skills	0.68	Significant positive
PBL Model → Curiosity Character	0.54	Significant positive
Curiosity Character → Critical Thinking Skills	0.45	Significant positive

The ethnomathematics-based Problem-Based Learning (PBL) model shows a significant direct effect on critical thinking skills with a coefficient of 0.68, while also providing a positive impact on the character of curiosity with a coefficient of 0.54. In addition, the character of curiosity also directly contributes to improving critical thinking skills with a coefficient of 0.45. This shows that the application of the ethnomathematics-based PBL model not only improves critical thinking skills directly but also through strengthening the character of curiosity as a mediator.

Table 5. R-Square (Model Power)

Dependent Variable	R-Square	Description
Critical Thinking Ability (Y1)	0.62	62% influenced by independent variables
Curiosity Character (Y2)	0.29	29% influenced by independent variables

From table 5 above shows that 62% of the variability of critical thinking skills can be explained by the application of the Problem Based Learning (PBL) model based on ethnomathematics and students' curiosity character, while the remaining 38% is influenced by other factors not examined in this study. In addition, 29% of the variability of the curiosity character can also be explained by the PBL model, with the rest influenced by other variables outside the scope of this study. This shows that the PBL model has a significant contribution to the development of students' critical thinking skills and curiosity character.

Table 6. Total Effect (Direct and Indirect Effects)

Relationship Between Variables	Immediate Effects	Indirect Effects	Total Effect
PBL Model → Critical Thinking Skills	0.68	0.24	0.92
PBL Model → Curiosity Character	0.54	-	0.54
Curiosity Character → Critical Thinking Skills	0.45	-	0.45

The PBL model has a total effect of 0.92 on critical thinking skills, both directly and through the character of curiosity. The indirect effect is calculated from the effect of the PBL Model on the Character of Curiosity which then affects Critical Thinking Skills.

The results of the SEM-PLS analysis show that the ethnomathematics-based PBL Model has a significant effect on students' critical thinking skills and curiosity character. This can be seen from the path coefficient of 0.68 in the relationship between the PBL Model and critical thinking skills, and 0.54 in the relationship between the PBL Model and curiosity character. With a high loading factor (>0.70), all indicators used are valid to represent latent variables. Indicators such as understanding ethnomathematics concepts, cultural relevance in learning, and student participation contribute significantly to supporting the effectiveness of the PBL Model in improving learning outcomes.

The effect of the PBL Model on critical thinking skills is also strengthened through students' curiosity character, with an indirect effect of 0.24. This shows that curiosity as measured by the indicators of paying attention, taking notes, asking questions, and comparing is an important mediator in strengthening the relationship between the PBL Model and critical thinking skills. In addition, the R-square value of 0.62 in critical thinking skills shows that 62% of the variability in these abilities can be explained by the PBL Model and curiosity character. This means that the implementation of ethnomathematics-based learning through the PBL approach is a key factor in improving students' critical thinking skills.

The effectiveness of the ethnomathematics-based PBL model is not only seen from its direct influence on critical thinking skills, but also from its total influence of 0.92 if considering its indirect influence through the character of curiosity. This emphasizes the importance of integrating local culture in learning to build students' curiosity while improving their critical thinking skills. Thus, these results provide important implications for teachers and educators to develop innovative learning strategies that are culturally relevant in order to achieve optimal learning outcomes.

Previous studies have shown that PBL is effective in improving critical thinking skills, increasing engagement, motivating students to think deeply [51]. Previous studies have also revealed that integrating local cultural elements into learning can increase the relevance of the material to everyday life, as well as increasing students' appreciation of cultural values [52]. For example, the use of ethnomathematics helps students understand abstract mathematical concepts through a familiar cultural context [15].

This study offers something new by integrating ethnomathematics into the problem-based learning (PBL) model, which has not been studied specifically regarding its impact on students' creative thinking skills. These findings provide new insights into how a culture-based approach can directly affect critical thinking skills as reviewed from the character of curiosity. In addition, this study also reveals the influence of learning models on the formation of a character of curiosity, showing that the cultural values contained in ethnomathematics are not

only academically relevant but also effective in instilling character in students [17]. By combining the improvement of critical thinking skills and the formation of a character of curiosity, this study offers a more holistic learning model that is relevant to the needs of 21st century education [53].

The implications of the results of this study include three main aspects, namely learning practices, curriculum, and further research. In learning practices, teachers can adopt the ethnomathematics-based PBL model as an effective strategy to improve students' critical thinking skills while instilling a character of curiosity, by contextualizing learning materials through local cultural elements such as traditional games of sungka or congklak. In terms of curriculum, these findings can be the basis for developing a more integrative curriculum, where ethnomathematics becomes an important part of science and mathematics teaching, thus supporting cross-disciplinary learning that instills character values in students [54]. In addition, this study opens up opportunities for further exploration of how other local cultural elements can be integrated into various learning models, as well as assessing their effectiveness in the context of different learning materials or student groups.

4. CONCLUSION

In conclusion, this study shows that the ethnomathematics-based problem-based learning (PBL) model significantly influences the improvement of students' creative thinking skills and the formation of a patriotic character. The integration of local cultural elements in learning not only provides contextual relevance but also supports the development of 21st-century skills holistically. By meeting statistical assumptions such as normality, multicollinearity, heteroscedasticity, and autocorrelation, this model is proven to be valid and effective. These findings provide new contributions to the educational literature by presenting an innovative approach that combines cultural values with modern learning, as well as providing a foundation for implementation in learning practices, curriculum development, and further research that focuses on the integration of local culture in education.

ACKNOWLEDGEMENTS

The researcher would like to express his gratitude to all parties involved in this research so that this research can run smoothly.

REFERENCES

[1] D. Setiawan, "The development of authentic assessment instrument to expand the character values of citizenship education at primary school No 104202 and No 106811 Bandar Setia, Medan, Indonesia," Budapest Int. Res. Critics Linguist. Educ. J., vol. 2, no. 1, pp. 79–90, Feb. 2019, doi: 10.33258/birle.v2i1.188.

[2] R. Dearamae, R. Safkolam, and M. Yacob, "An investigation of pre-service teachers' teaching active learning to be STEM Education," J. Phys. Conf. Ser., vol. 1835, no. 1, 2021, doi: 10.1088/1742-6596/1835/1/012065.

[3] E. N. Setiyani, W. Panomram, and T. Wangdi, "Development of Predict Observe Explain Based Flat Side Building Worksheets to Improve Students' Mathematical Representation Skills," Interval Indones. J. Math. Educ., vol. 2, no. 1, pp. 15–21, 2024, doi: 10.37251/ijome.v2i1.984.

[4] S. Suherman and T. Vidákovich, "Assessment of mathematical creative thinking: A systematic review," Think. Ski. Creat., vol. 44, no. January, 2022, doi: 10.1016/j.tsc.2022.101019.

[5] N. Nuryadi, L. Kurniawan, and I. Kholifa, "Developing mobile learning based on ethnomathematics viewed from adaptive e-learning: Study of two dimensions geometry on Yogyakarta palace's chariot," Int. J. Educ. Learn., vol. 2, no. 1, pp. 32–41, 2020, doi: 10.31763/ijele.v2i1.85.

[6] L. Hasibuan and A. Nugraha, "Development of Scientific and Constructivism-Based Handouts on Social Arithmetic Materials," Indones. J. Educ. Res., vol. 4, no. 2, pp. 28–31, 2023, doi: 10.37251/ijoer.v4i2.578.

[7] P. da S. Finamore et al., "Nigerian politicians, discipline, integrity, character and the rule of law: Application versus financial spending in 2019 federal elections," J. Chem. Inf. Model., vol. 53, no. February, p. 2021, 2021, doi: 10.13140/RG.2.2.19482.59846.

[8] A. M. I. T. Asfar, A. M. I. A. Asfar, and A. Nurannisa, "Integration of Local Traditions Bugis-Makassarese: Learning Strategies to Improve Mathematical Communication Skills," IOP Conf. Ser. Earth Environ. Sci., vol. 1808, no. 1, 2021, doi: 10.1088/1742-6596/1808/1/012064.

[9] H. Kurniawan, R. Y. Purwoko, and D. S. Setiana, "Integrating cultural artifacts and tradition from remote regions in developing mathematics lesson plans to enhance mathematical literacy," J. Pedagog. Res., vol. 8, no. 1, pp. 61–74, 2024, doi: 10.33902/JPR.202423016.

[10] F. B. Agusto, M. I. Teboh-Ewungkem, and A. B. Gumel, "Mathematical assessment of the effect of traditional beliefs and customs on the transmission dynamics of the 2014 Ebola outbreaks," BMC Med., vol. 13, no. 1, pp. 1–17, 2015, doi: 10.1186/s12916-015-0318-3.

[11] Mellawaty, Y. L. Sukestiyarno, I. Isnarto, and Z. Zaenuri, "Learning mathematics through ethnomatematics studies containing character values and cognitive aspects in congklak games for children of the Dayak Losarang Tribe," Int. Conf. Sci. Educ. Technol., vol. 9, no. 1, pp. 475–483, 2023.

[12] Y. Kuswardi, F. Nurhasanah, B. Usodo, H. Ekana, S. Sutopo, and M. Shahrill, "A Learning Trajectory for Statistics Through the Traditional Game of Congklak to Enhance Mathematical Reasoning Skills," Int. J. Pedagog. Teach. Educ., vol. 8, no. 1, p. 111, 2024, doi: 10.20961/ijpte.v8i1.90547.

[13] S. M. Syahnia, E. Y. Haenilah, R. Perdana, and C. Caswita, "Ethnomathematics-based Problem Based Learning (PBL)

Model to Increase Students' Critical Thinking in Mathematics Learning," Lect. J. Pendidik., vol. 15, no. 2, pp. 571–581, 2024, doi: 10.31849/lectura.v15i2.20985.
[14] L. A. Maharani and S. B. Waluya, "Systematic Literature Review: Implementation of a Problem-Based Learning Model with Ethnomathematics Nuances in Improving Students' Mathematical Problem Solving Ability," J. Pendidik. Mat., vol. 1, no. 2, p. 13, 2023, doi: 10.47134/ppm.v1i2.218.
[15] D. Purwanti, □ Zaenuri, and M. Asikin, "Problem Solving Ability in the Learning Model of Problem-Based Learning based on Ethnomathematics," J. Prim. Educ., vol. 10, no. 1, pp. 113–120, 2021, [Online]. Available: https://journal.unnes.ac.id/sju/index.php/jpe/article/view/34303
[16] U. A. Dahlan and J. R. Selatan, "Fajri Nur Hidayati, Rully Charitas Indra Prahmana," Ethnomathematics' Res. Indones., vol. 1, no. 1, pp. 29–42, 2022, [Online]. Available: http://doi.org/10.48135/ije.v1i1.29-42
[17] R. C. I. Prahmana and U. D'Ambrosio, "Learning geometry and values from patterns: Ethnomathematics on the batik patterns of yogyakarta, indonesia," J. Math. Educ., vol. 11, no. 3, pp. 439–456, 2020, doi: 10.22342/jme.11.3.12949.439-456.
[18] J. Munthahana, M. Teguh Budiarto, and A. Wintarti, "Indonesian Journal of Science and Mathematics Education The Application Of Ethnomathematics In Numeracy Literacy Perspective: A Literature Review Article Info ABSTRACT," Indones. J. Sci. Math. Educ., vol. 06, no. July, pp. 177–191, 2023, doi: 10.24042/ijsme.v5i1.17546.
[19] C. P. Vistro-Yu, "Ethnomathematics for Capacity Building in Mathematics Education," pp. 2–15, 2010, [Online]. Available: https://www.researchgate.net/publication/364934080
[20] R. L. Alabat and A. M. Oledan, "A Meta-Synthesis on the Challenges and Benefits of Integrating Ethnomathematics in the Philippine Mathematics Curriculum," J. Educ. Pract., no. September, 2024, doi: 10.7176/jep/15-8-04.
[21] S. Mystakidis, M. Fragkaki, and G. Filippousis, "Ready teacher one: Virtual and augmented reality online professional development for k-12 school teachers," Computers, vol. 10, no. 10, pp. 1–16, 2021, doi: 10.3390/computers10100134.
[22] N. V. Telegina, S. E. Drovosekov, D. G. Vasbieva, and V. L. Zakharova, "The use of project activity in teaching mathematics," Eurasia J. Math. Sci. Technol. Educ., vol. 15, no. 8, 2019, doi: 10.29333/ejmste/108439.
[23] N. Marliani, "Peningkatan Kemampuan Berpikir Kreatif Matematis Siswa melalui Model Pembelajaran Missouri Mathematics Project (MMP)," Form. J. Ilm. Pendidik. MIPA, vol. 5, no. 1, pp. 14–25, 2015, doi: 10.30998/formatif.v5i1.166.
[24] E. F. Crawley, A. Hosoi, G. L. Long, T. Kassis, W. Dickson, and A. B. Mitra, Moving Forward with the New Engineering Education Transformation (NEET) program at MIT - Building community, developing projects, and connecting with industry. 2019. doi: 10.18260/1-2--33124.
[25] D. Ramdani, H. Susilo, Suhadi, and Sueb, "The Effectiveness of Collaborative Learning on Critical Thinking, Creative Thinking, and Metacognitive Skill Ability: Meta-Analysis on Biological Learning," Eur. J. Educ. Res., vol. 11, no. 3, pp. 1607–1628, 2022, doi: 10.12973/eu-jer.11.3.1607.
[26] F. Kiraga, "Literature Review: Efforts To Improve Creative Thinking Ability In Science Learning," Integr. Sci. Educ. J., vol. 4, no. 2, pp. 77–83, 2023, doi: 10.37251/isej.v4i2.330.
[27] S. Syutaridho, F. Ramury, and N. Nurhijah, "The Influence Of Indonesia's Realistic Mathematics Education Approach On Students' Creative Thinking Ability," J. Ilm. Ilmu Terap. Univ. Jambi, vol. 7, no. 2, pp. 99–111, 2023, doi: 10.22437/jiituj.v7i2.28700.
[28] Ch. Diawati, N. Fadiawati, and K. Herlina, "Teachers' and Students' Perception about Creative Thinking Skills, Immersed Integrated Science Learning, and project-based Learning: A cow dung waste issue," J. Pendidik. dan Pembelajaran Kim., vol. 9, no. 2, pp. 108–113, 2020, doi: 10.23960/jpk.v9.i2.202010.
[29] T. Aytaç and S. S. Kula, "The Effect of Student-Centered Approaches on Students' Creative Thinking Skills: A Meta-Analysis Study.," Int. J. Contemp. Educ. Res., vol. 7, no. 2, pp. 62–80, 2020.
[30] N. Tor and G. Gordon, "Digital interactive quantitative curiosity assessment tool: Questions worlds," Int. J. Inf. Educ. Technol., vol. 10, no. 8, pp. 614–621, 2020, doi: 10.18178/ijiet.2020.10.8.1433.
[31] E. M. Rosa, S. Sundari, E. R. Ambarwati, G. Suryandari, E. Rochmawati, and F. Suryanto, "'E-Matching Card' to Improve Cooperation and Cognitive Abilities Among Nursing Students," J. Keperawatan Indones., vol. 26, no. 2, pp. 89–96, 2023, doi: 10.7454/jki.v26i2.1136.
[32] D. Bautista and R. Dionido, "Mastering the Game of Sungka from Random Play," pp. 1–6, 2019, [Online]. Available: http://arxiv.org/abs/1905.07102
[33] J. Jusmaniar, I. Riani, E. C. Anderson, M. C. Lee, and S. W. Oktavia, "Gasing Game: Ethnoscientific Exploration of Circular Motion in Physics Learning on the Coast of East Sumatra to Build the Character of Perseverance," Schrödinger J. Phys. Educ., vol. 5, no. 1, pp. 1–9, 2024, doi: 10.37251/sjpe.v5i1.902.
[34] P. Lavega, Q. Prat, U. S. De Ocáriz, J. Serna, and V. Muñoz-Arroyave, "Aprendizaje basado en la reflexión sobre la acción a través de los juegos tradicionales. El caso de la pelota sentada," Cult. y Educ., vol. 30, no. 1, pp. 142–176, 2018, doi: 10.1080/11356405.2017.1421302.
[35] I. K. Hendry, W. Kusuma, M. Asmawi, and F. Dlis, "A Study of Learning Physical Fitness Activities Based on Traditional Balinese Sports Games for Students ' Physical Fitness," Int. J. Hum. Mov. Sport. Sci., vol. 9, no. 5, pp. 1029–1039, 2021, doi: 10.13189/saj.2021.090525.
[36] X. Wang and Z. Liu, "Three-Dimensional Reconstruction of National Traditional Sports Cultural Heritage Based on Feature Clustering and Artificial Intelligence," Comput. Intell. Neurosci., vol. 2022, 2022, doi: 10.1155/2022/8159045.
[37] T. Kogoya et al., "Developing the Value of Peace in Sport, Health, and Physical Education Lecture through Traditional Games," Int. J. Hum. Mov. Sport. Sci., vol. 11, no. 2, pp. 268–275, 2023, doi: 10.13189/saj.2023.110202.
[38] I. M. Hasibuan, "Anshara International Journal of Education and Science (AIJoES) Analysis of Honorary Teacher Well-being," Lubis/ AIJoES, vol. 1, no. 1, pp. 12–15, 2024, [Online]. Available: https://journal.anshara.id/index.php
[39] I. Aboutajedyne, M. S. Houssaini, A. Aboutajeddine, Y. S. Alj, and M. El Mohajir, "A design model for the development of non-traditional educational activities," in Colloquium in Information Science and Technology, CIST, 2020, pp. 242–

247. doi: 10.1109/CiSt49399.2021.9357317.
[40] A. Asrial, S. Syahrial, D. A. Kurniawan, and M. D. Zulkhi, "The Relationship Between the Application of E-Modules Based on Mangrove Forest Ecotourism on The Peace-Loving Character of Students," J. Educ. Technol., vol. 5, no. 3, p. 331, 2021, doi: 10.23887/jet.v5i3.34043.
[41] Y. Yantoro, D. A. Kurniawan, R. Perdana, and P. A. Rivani, "A Survey of Process Skills Mathematics Learning in Elementary School," J. Pendidik. dan Pengajaran, vol. 54, no. 3, pp. 467–474, 2021, doi: 10.23887/jpp.v54i3.37180.
[42] K. Kamid, D. A. Kurniawan, and A. M. Nawahdani, "Scientific Learning Model: Analytical Thinking and Process Skills in Mathematics," J. Educ. Res. Eval., vol. 6, no. 3, pp. 238–249, 2022, doi: 10.23887/jere.v6i3.49159.
[43] H. Ames, C. Glenton, and S. Lewin, "Purposive sampling in a qualitative evidence synthesis," BMC Med. Res. Methodol., 2019.
[44] S. Campbell et al., "Purposive sampling: complex or simple? Research case examples," J. Res. Nurs., 2020, doi: 10.1177/1744987120927206.
[45] F. Ilmiyatni, T. Jalmo, and B. Yolida, "Pengaruh Problem Based Learning Terhadap Keterampilan Kolaborasi dan Berpikir Tingkat Tinggi," J. Bioterdidik, vol. 7, no. 2, pp. 35–45, 2019.
[46] R. Ennis, "Inquiry: Critical thinking across the Disciplines," Philos. Doc. Cent., vol. 26, no. 2, pp. 15–17, 2011, [Online]. Available: https://www.pdcnet.org/inquiryct/content/inquiryct_2011_0026_0002_0005_0019
[47] Herwin and R. Nurhayati, "Measuring students' curiosity character using confirmatory factor analysis," Eur. J. Educ. Res., vol. 10, no. 2, pp. 773–783, 2021, doi: 10.12973/EU-JER.10.2.773.
[48] Y. Zhou, Y. Zhu, and W. K. Wong, "Statistical tests for homogeneity of variance for clinical trials and recommendations," Contemp. Clin. Trials Commun., vol. 33, no. March, p. 101119, 2023, doi: 10.1016/j.conctc.2023.101119.
[49] E. Simamora, A. Mansyur, and E. Wydiastuti, "Bootstrap Percentile for Estimating Confidence Interval of Heteroscedasticity Linear Regression Model Parameters," in AIP Conference Proceedings, 2022, pp. 1–7. doi: 10.1063/5.0113065.
[50] V. Berenguer-Rico and I. Wilms, "Heteroscedasticity testing after outlier removal," Econom. Rev., vol. 40, no. 1, pp. 51–85, 2021, doi: 10.1080/07474938.2020.1735749.
[51] Munawaroh, N. S. Setyani, L. Susilowati, and Rukminingsih, "The Effect of E-Problem Based Learning on Students' Interest, Motivation and Achievement," Int. J. Instr., vol. 15, no. 3, pp. 503–518, 2022, doi: 10.29333/iji.2022.15328a.
[52] S. A. Anggita, M. A. Mahboob, and S. S. Bin Hussein, "Celebrating the Prophet's Birthday: a Manifestation of the Character of Cooperation in Islamic Education," J. Pendidik. Agama Islam Indones., vol. 5, no. 1, pp. 22–29, 2024, doi: 10.37251/jpaii.v5i1.907.
[53] M. Romero, P. Hyvonen, and E. Barbera, "Creativity in Collaborative Learning across the Life Span," Creat. Educ., vol. 03, no. 04, pp. 422–429, 2012, doi: 10.4236/ce.2012.34066.
[54] M. T. Magiera and V. S. Zambak, "Exploring prospective teachers' ability to generate and analyze evidence-based explanatory arguments," Int. J. Res. Educ. Sci., vol. 6, no. 2, pp. 327–346, 2020, doi: 10.46328/ijres.v6i2.765.