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THE EFFECTIVENESS OF IMPLEMENTING THE STEAM APPROACH BASED ON PROJECT-BASED LEARNING (PJBL) ON MIDDLE SCHOOL STUDENTS' SELF-CONFIDENCE AND CREATIVITY

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Abstract:
This study aims to determine the self-confidence and creativity of Grade VIII students of SMP Negeri 33 Makassar and also to evaluate the effectiveness of implementing the STEAM approach based on Project Based Learning at SMP Negeri 33 Makassar. The research sample consisted of two classes which were then divided into a control class and an experimental class. The experimental class was given treatment in the form of applying the STEAM approach based on project-based Learning. The main instrument in this study was the researcher. The supporting instruments used were student response questionnaires, student self-confidence questionnaires, student activity observation sheets, and student creativity observation sheets. Then the data obtained is processed and interpreted. The results showed that: (1) The self-confidence of students who were taught using the STEAM approach based on Project Based Learning was better than those taught with conventional learning models. (2) the creativity of students taught with the STEAM approach based on Project Based Learning is better than those taught with conventional learning models. (3) The application of project-based Learning-based STEAM Approach is effectively applied in learning mathematics material in class VIII SMP Negeri 33 Makassar.

Keywords: Creativity, Project Based Learning, Self Confidence, STEAM

EFEKTIVITAS PENERAPAN PENDEKATAN STEAM BERBASIS PROJECT BASED LEARNING (PJBL) TERHADAP KEPERCAYAAN DIRI DAN KREATIVITAS SISWA SMP

Abstrak:
Penelitian ini bertujuan untuk mengetahui kepercayaan diri dan kreativitas siswa kelas VIII SMP Negeri 33 Makassar dan juga mengetahui efektivitas penerapan pendekatan STEAM berbasis Project Based Learning di SMP Negeri 33 Makassar. Sampel penelitian terdiri atas dua kelas yang kemudian dibagi menjadi kelas kontrol dan kelas eksperimen. Di mana kelas eksperimen diberikan perlakuan berupa penerapan pendekatan STEAM berbasis Project Based Learning sedangkan kelas kontrol menggunakan pembelajaran konvensional. Instrumen utama dalam

penelitian ini adalah peneliti dan instrument pendukung yang digunakan adalah angket respon siswa, angket kepercayaan diri siswa, lembar observasi aktivitas siswa, dan lembar observasi kreativitas siswa. Data yang diperoleh kemudian diuji secara statistik dan diinterpretasikan. Hasil penelitian menunjukkan bahwa: (1) Kepercayaan diri siswa yang diajar dengan pendekatan STEAM berbasis Project Based Learning lebih baik daripada siswa yang diajarkan dengan model pembelajaran konvensional. (2) kreativitas siswa yang diajar dengan pendekatan STEAM berbasis Project Based Learning lebih baik daripada yang diajar dengan model pembelajaran konvensional. (3) Penerapan Pendekatan STEAM berbasis Project Based Learning efektif diterapkan dalam pembelajaran matematika materi lingkaran kelas VIII SMP Negeri 33 Makassar.

Kata Kunci: Kepercayaan Diri, Kreativitas, Project Based Learning, STEAM

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INTRODUCTION

Education is a cornerstone of a nation's development. The quality of education is influenced by various factors, including teachers, learning resources, and facilities. According to Ministry of Education and Culture of Republik Indonesia (2016), the learning process should be student-centered, creating an enjoyable, interactive, and inspiring environment that allows students to develop creativity in alignment with their talents, interests, and physical and psychological growth. Unfortunately, the current practice in many schools falls short of these expectations.

The Deputy Secretary-General of the Indonesian Teachers Union Federation (FSGI), Satriwan Salim, highlighted that many schools still implement teacher-centered learning systems. This approach leads to passive students, negatively affecting their comprehension of materials, learning motivation, and overall achievement (Retnani, Sukardjo, & Utomo, 2014). Such systems also hinder the development of students' affective and psychomotor domains, including their self-confidence and creativity, which are essential for meeting the challenges of the 21st century.

Student learning outcomes encompass three main domains: cognitive, affective, and psychomotor (Lestari, Eraku, & Rusiyah, 2021). The cognitive

domain includes knowledge, comprehension, application, analysis, synthesis, and evaluation. The affective domain involves receiving, responding, valuing, organizing, and characterizing. The psychomotor domain consists of perception, readiness, guided responses, habitual movements, complex movements, adaptation, and creativity. However, in practice, learning outcomes are often evaluated solely based on the cognitive domain, neglecting critical aspects such as self-confidence (affective) and creativity (psychomotor). STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning also focuses on integrating various disciplines to create a more holistic and relevant learning experience for students (Asdar, Arwadi, & Rismayanti, 2021).

Previous studies have demonstrated the importance of active student engagement through innovative learning approaches, such as STEAM (Science, Technology, Engineering, Art, Mathematics) Learning. STEAM Learning integrates knowledge across disciplines while fostering creativity. One effective learning model aligned with STEAM is Project-Based Learning (PjBL) (Andhianto, Fitriani, & Nuroniah, 2024). This model requires students to collaborate on projects based on real-world problems, enhancing not only cognitive achievements but also fostering self-confidence and creativity.

Despite its potential, there is a scarcity of research exploring the relationship between STEAM-based PjBL and students' self-confidence and creativity. Most prior studies have primarily focused on cognitive learning outcomes, overlooking the affective and psychomotor domains (Budiyono, Husna, & Wildani, 2020). Therefore, this study aims to investigate how a STEAM-based Project-Based Learning approach can enhance junior high school students' self-confidence and creativity in mathematics education.

This research is significant because it provides both theoretical and practical contributions to the development of learning models that support 21st-century skills (Zubaidah, 2019). By emphasizing self-confidence and creativity, this study seeks to improve the quality of education in Indonesia while addressing existing research gaps.

METHODS

The method used in this research is a quantitative approach with an experimental type. The research method applied is the quasi-experimental design. A quasi-experimental design is a research framework that includes a control group but does not fully manage external variables that may influence the experiment's implementation (Kurniati, Muhandaz, & Hamzah, 2017). In

this case, the study involves one class as the experimental group and another as the control group (Pentang, 2023). The experimental class receives treatment intending to assess the effectiveness of the STEAM approach based on Project-Based Learning on students' self-confidence and creativity and the control group's learning method is left as usual (Subekti & Ariswan, 2016).

The instruments used in this research are a self-confidence questionnaire and a creativity observation sheet. The self-confidence questionnaire is designed to determine the level of self-confidence among students, both those who have received the treatment and those who have not. Meanwhile, the creativity observation sheet is used to assess the level of creativity among students, both in the experimental and control groups (Conradty & Bogner, 2020).

After obtaining the results from the self-confidence questionnaire and the creativity observation sheet, the data will be analyzed descriptively to determine the levels of self-confidence and creativity among eighth-grade students at SMP Negeri 33 Makassar. The results will be categorized into five levels of self-confidence: very high, high, moderate, low, and very low. Similarly, the creativity levels will also be into five categories: very high, high, moderate, low, and very low (Haase, Hoff, Hanel, & Innes-Ker, 2018).

The data will also be analyzed inferentially using statistical software, followed by interpretation in terms of the students' self-confidence and creativity (Smith, 2018). As well as the effectiveness of the STEAM approach based on Project-Based Learning on self-confidence and creativity among eighth-grade students at SMP Negeri 33 Makassar.

RESULTS AND DISCUSSION

1. Confidence Level of Grade VIII Students of SMP Negeri 33 Makassar

Student confidence is seen from the score of the confidence questionnaire in the experimental class and control after learning using the STEAM approach based on Project Based Learning. The results obtained are as follows.

Table 1. Results of Descriptive Statistics on the Self-Confidence of Grade VIII Students of SMP Negeri 33 Makassar after the Implementation of the STEAM Approach based on Project-Based Learning

Statistics	Experimental Classes	Control Classes
Sample Size	22	22
Lowest Rate	48	32
Highest Scores	74	60
Range	26	28
Mean	60.36	48.82
Standard Deviation	6.65	7.31
Variance	44.24	53.39

Table 1 shows that the average value in the control class is 48.82 with a standard deviation of 7.31, indicating that the data is quite scattered, meaning that the variation in the value in the data is quite large. A variance of 53.39 also shows that the values in the data are quite varied. Where in the experimental class it shows that the average score in the experimental class is 60.36. The standard deviation of 6.65 shows that the data is quite scattered, the average deviation of the standard and the central value is 6.65. The variance of 44.24 also shows that the values in the data are quite varied.

Table 2. Distribution of Confidence Frequency of Grade VIII Students of SMP Negeri 33 Makassar after the implementation of the STEAM Approach based on Project-Based Learning

No.	Interval Value	Category
1	$x > 68$	Very High
2	$56 < x \leq 68$	High
3	$44 < x \leq 56$	Normal
4	$32 < x \leq 44$	Low
5	$x \leq 32$	Very Low

Based on the table, it is known that the average confidence score of the experimental class is in the high category, while the control class is in the medium category. In addition, the standard deviation and variance values in both data groups showed that both groups had considerable variation in students' confidence scores, both taught using the PjBL-based STEAM approach and not.

2. Creativity Level of Grade VIII Students of SMP Negeri 33 Makassar

Data was obtained from observation with the Creativity Observation Sheet (Kusumaningtyas, Jumadi, & Istiyono, 2020). Observations were carried out during Learning using the STEAM approach based on Project Based Learning., the results obtained were as follows.

Table 3. Descriptive Statistics Results of Creativity of Grade VIII Students of SMP Negeri 33 Makassar after the implementation of the STEAM Approach based on Project-Based Learning

Statistics	Experimental Classes	Control Classes
Sample Size	12	12
Lowest Rate	44	39
Highest Scores	50	44
Range	6	5
Mean	46.58	40.92
Standard Deviation	1.92	1.88
Variance	3.72	3.53

Table 3 shows that the average value in the control class is 46.58 with a standard deviation of 1.92, indicating that the data is quite scattered, meaning that the variation in the values in the data is quite large. A variance of 3.72 also shows that the values in the data are quite varied. Whereas the experimental class had an average score of 40.92 with a variance of 3.53.

Table 4. Distribution of Creativity Frequency of Grade VIII Students of SMP Negeri 33 Makassar after the Implementation of the STEAM Approach based on Project-Based Learning

No.	Interval Value	Category
1	$x > 45.5$	Very High
2	$39.2 < x \leq 45.5$	High
3	$30.8 < x \leq 39.2$	Medium
4	$22.4 < x \leq 30.8$	Low
5	$x \leq 22.4$	Very Low

Based on the table, it is known that the average creativity score of the experimental class is in the very high category while the control class is in the high category. From this information, it can be concluded that the experimental class has a higher average score than the control class. However,

the standard deviation in the two sample groups was not much different, so the variability in both groups was almost the same.

3. Hypothesis Test of Data Confidence and Creativity of Grade VIII Junior High School Grade 33 Junior High School Students

The data obtained has met the prerequisites of analysis, namely normal distribution and homogeneous variance. A hypothesis test is carried out using an Independent sample t-test, with the test criteria of sig. (2 tailed) < 0.05, then H_0 rejected and H_1 accepted. On the other hand, if sig. (2 tailed) > 0.05, then H_0 is accepted and H_1 rejected. The results of the independent samples t-test for student confidence and creativity can be seen in table 5.

Table 5. Independent Sample t-Test for Grade VIII Students of SMP Negeri 33 Makassar after the implementation of the STEAM Approach based on Project-Based Learning

Independent Samples t-test	Sig. (2 tailed)	Mean Difference
Confidence	0.002	11.545
Creativeness	0.001	5.667

Based on the results of the independent samples t-test in table 5 show that student confidence has a significance value of 0.00 < 0.05, meaning that H_0 rejected and H_1 accepted, so it can be said that the confidence of students who are taught by applying the STEAM approach based on Project Based Learning is better than the confidence of students who are taught without applying the STEAM approach based on Project Based Learning.

4. Student Confidence

Student confidence is a description of how students believe in their abilities, strengths, and judgments of themselves, which can be seen from the scores they get from filling out questionnaires after the implementation of Learning (Maryam, Kusmiyati, Merta, & Artayasa, 2020). In this case, the application of the STEAM approach based on project-based Learning is said to be effective if students achieve high self-confidence criteria.

In this study, the application of the STEAM approach itself has an impact on students' confidence. Where students have fulfilled several indicators of self-confidence, namely students can develop themselves by knowing their own abilities, they can relate to the environment and recognize

the attitudes of individuals around them, and they can look at and judge themselves positively or negatively (Dywan & Airlanda, 2020).

Based on the results of the previous study, descriptively, the confidence score of students in class VIII A (experimental class) of SMP Negeri 33 Makassar who participated in learning with the PjBL-based STEAM approach varied with an average of 60.36 in the high category in the interval of 56-68 with a standard deviation of 6.65.

Descriptively, it is also known that the confidence score of students in class VIII C (control class) of SMP Negeri 33 Makassar who participated in Learning using the conventional model with an average of 48.82 was in the medium category with an interval of 44-56 with a standard deviation of 7.307.

In inferential analysis, the student's confidence score was obtained with an opportunity value of sig. = 0.000 with $\alpha = 0.05$, and then statistically, the hypotheses H_0 ditolak and H_1 were accepted. So it can be concluded that the confidence of students who are taught by applying the STEAM approach based on Project Based Learning is better than the confidence of students who are taught without applying the STEAM approach based on Project Based Learning.

Based on the results of the analysis, it is descriptively and inferentially seen that the confidence score of students in grade VIII A SMP Negeri 33 Makassar who participate in learning with the STEAM approach based on Project Based Learning is better than students in grade VIII C SMP Negeri 33 Makassar who participate in learning with a conventional model.

Based on theory, the STEAM approach based on Project Based Learning can increase student confidence, resulting, resulting in increased student activity during the learning process compared to conventional models (Lin & Tsai, 2021). This is because, with this learning model, students will have time to think about concepts according to their respective knowledge, and this can improve students' relationships with other students in class (Ozkan & Umdu Topsakal, 2021).

Even so, there are still students in the experimental class who have less confidence due to factors that cannot be avoided by researchers, such as there are students who are not present at 1 or 2 meetings but still fill out a confidence questionnaire so that in filling out the questionnaire students do not understand how to fill out the questionnaire.

5. Student Creativity

Student creativity is always associated with a creative product. Where in this case how are students trying to produce creative solutions or products based on the problems given? Students have at least two aspects of creativity: process and creative assessment (Amalia, Sutarto, & Pranoto, 2022).

The development of student creativity in Learning is one of the important things because if students do not have creativity, the learning process will be static, meaning there is no back-and-forth interaction between educators and students (Arsy & Syamsulrizal, 2021).

In this study, the application of the STEAM approach itself has an impact on student creativity, where students are expected to have three main components of creativity, namely, (1) fluency, which is the ability to produce several ideas; (2) flexibility, which is looking for many alternative solutions; (3) originality, which can give birth or create something new/original (Widana & Septiari, 2021).

Based on the results of creativity observations carried out during the learning process both in the experimental and control classes. Where the average score obtained from the observation results of the experimental class was 46.58 in the very high category. As for the control class, the average score of the observation results is 40.92 which is in the high category.

These results show that the creativity score of the experimental class taught using the Project-Based Learning-based STEAM approach is better than the control class taught using the conventional learning model.

The results of the second hypothesis analysis show that applying the STEAM approach based on Project Learning affects the creativity of grade VIII students of SMP Negeri 33 Makassar. This can be proven by the significance value of the results of the creativity hypothesis test, which is $0.00 < 0.05$ so that it is H_0 rejected and H_1. So it can be said that the creativity of students who are taught by applying the STEAM approach based on project-based Learning is better than the creativity of students who are taught without applying the STEAM approach based on project-based Learning.

CONCLUSION

The average score of students' confidence after applying the STEAM approach based on Project Based Learning was 60.36 with a high category. So it can be concluded that the confidence of students who are taught with the

STEAM Approach based on Project Based Learning is better than those taught with conventional learning models.

The average score of students' creativity after applying the STEAM Approach based on Project-Based Learning was 53.64 with a high category. So it can be concluded that the creativity of students taught with the STEAM Approach based on Project-Based Learning is better than that taught with conventional learning models.

The application of the STEAM Approach based on Project-Based Learning in grade VIII of SMPN 33 Makassar meets the indicators of learning effectiveness, namely, (1) student confidence reaches the high category, (2) student creativity reaches the high category, (3) student activities are in the active category, and (4) student responses to Learning are in the positive category, so the application of the STEAM Approach based on Project-Based Learning effectively applied in mathematics learning in grade VIII of SMP Negeri 33 Makassar.

REFERENCES

Amalia, D., Sutarto, J., & Pranoto, Y. K. S. (2022). Pengaruh pembelajaran jarak jauh bermuatan STEAM terhadap karakter kreatif dan kemandirian. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, *6*(3), 1233–1246. https://doi.org/10.31004/obsesi.v6i3.1765.

Andhianto, P. A., Fitriani, Y., & Nuroniah, P. (2024). Penerapan pembelajaran STEAM berbasis proyek penguatan profil pelajar pancasila (P5) di satuan PAUD. *Murhum: Jurnal Pendidikan Anak Usia Dini*, *5*(1), 314–326. https://doi.org/10.37985/murhum.v5i1.547.

Arsy, I., & Syamsulrizal. (2021). Pengaruh pembelajaran STEAM (science, technology, arts, and mathematics) terhadap kreativitas peserta didik. *Biolearning Journal*, *8*(1), 24–27. https://doi.org/10.36232/ jurnalbiolearning.v8i1.1019.

Asdar, F., Arwadi, F., & Rismayanti. (2021). Pendekatan pendidikan matematika realistik terhadap hasil belajar matematika dan self-confidence siswa SMP. *Plusminus Jurnal Pendidikan Matematika*, *1*(1), 1–16. https://doi.org/10.31980/plusminus.v1i1.857.

Budiyono, A., Husna, H., & Wildani, A. (2020). Pengaruh penerapan model pbl terintegrasi steam terhadap kemampuan berpikir kreatif ditinjau dari pemahaman konsep siswa. *Jurnal Edusains*, *12*(2), 166–176.

Conradty, C., & Bogner, F. X. (2020). STEAM teaching professional development works: Effects on students' creativity and motivation. *Smart Learning Environments*, *7*(1), 26. https://doi.org/10.1186/s40561-020-00132-9.

Dywan, A. A., & Airlanda, G. S. (2020). Efektivitas model pembelajaran project-based learning berbasis STEM dan tidak berbasis STEM terhadap keterampilan berpikir kritis siswa. *Jurnal Basicedu*, *4*(2), 344–354. https://doi.org/10.31004/basicedu.v4i2.353.

Haase, J., Hoff, E. V., Hanel, P. H., & Innes-Ker, A. (2018). A meta-analysis of the relation between creative self-efficacy and different creativity measurements. *Creativity Research Journal*, *30*(1), 1–16. https://doi.org/10.1080/10400419.2018.1411436.

Kurniati, A., Muhandaz, R., & Hamzah, F. A. (2017). Pengaruh penerapan metode pembelajaran kelompok buzz terhadap kemampuan komunikasi matematika siswa. *Suska Journal of Mathematics Education*, *3*(2), 111–118. https://doi.org/10.24014/sjme.v3i2.3525.

Kusumaningtyas, D. A., Jumadi, & Istiyono, E. (2020). *Buku panduan mahasiswa untuk pembelajaran STEM ISCIT*. Yogyakarta: PT Viva Victory Abadi.

Lestari, N. A., Eraku, S. S., & Rusiyah. (2021). Pengaruh pembelajaran project-based learning berintegrasikan science, technology, engineering, and mathematics (STEM) terhadap hasil belajar geografi di SMA Negeri 1 Gorontalo. *Jambura Geo Education Journal*, *2*(2), 70–77. https://doi.org/10.34312/jgej.v2i2.11587.

Lin, C. L., & Tsai, C. Y. (2021). The effect of a pedagogical STEAM model on students' project competence and learning motivation. *Journal of Science Education and Technology*, *30*(1), 112–124. https://doi.org/10.1007/s10956-020-09885-x.

Maryam, M., Kusmiyati, K., Merta, I. W., & Artayasa, I. P. (2020). Pengaruh model pembelajaran inkuiri terhadap keterampilan berpikir kritis siswa. *Jurnal Pijar MIPA*, *15*(3), 206–213. https://doi.org/10.29303/jpm.v15i3.1355.

Ministry of Education and Culture of Republik Indonesia. (2016). *Peraturan menteri pendidikan dan kebudayaan republik indonesia nomor 22 tahun 2016 tentang standar proses pendidikan dasar dan menengah*. Jakarta: Kemendikbud.

Ozkan, G., & Umdu Topsakal, U. (2021). Investigating the effectiveness of STEAM education on students' conceptual understanding of force and energy topics. *Research in Science & Technological Education*, *39*(4), 441–460. https://doi.org/10.1080/02635143.2020.1769586.

Pentang, J. (2023). Quantitative research instrumentation for educators. Wesleyan University.

Retnani, F. Y., Sukardjo, J. S., & Utomo, S. B. (2014). Penerapan metode numbered heads together (NHT) disertai Macromedia Flash untuk meningkatkan motivasi dan prestasi belajar siswa materi struktur atom, sistem periodik, dan ikatan kimia kelas XI IPA 4 SMA Negeri 2 Boyolali tahun pelajaran 2013/2014. *Jurnal Pendidikan Kimia Universitas Sebelas Maret*, *3*(3), 57–65.

Smith, H. M. (2018). *Exploring students' internal motivation for engineering creativity: creative confidence and the arts*. Queen's University.

Subekti, Y., & Ariswan. (2016). Pembelajaran fisika dengan metode eksperimen untuk meningkatkan hasil belajar kognitif dan keterampilan proses sains. *Jurnal Inovasi Pendidikan IPA*, *2*(2), 252–261. https://doi.org/10.21831/jipi.v2i2.6278.

Widana, W., & Septiari, K. L. (2021). Kemampuan berpikir kreatif dan hasil belajar matematika siswa menggunakan model pembelajaran project-based learning berbasis pendekatan STEM. *Jurnal Elemen*, *7*(1), 209–220. https://doi.org/10.29408/jel.v7i1.3031.

Zubaidah, S. (2019). STEAM (science, technology, engineering, arts, and mathematics): Pembelajaran untuk memberdayakan keterampilan abad ke-21. In *Seminar Nasional Matematika Dan Sains, September* (pp. 1-18).