Journal of Social Knowledge Education (JSKE)
Vol. 4, No. 3, August 2023, pp. 103~110
ISSN: 2722-046X, DOI: 10.37251/jske.v4i3.701

The Effect of the Flipped Classroom Model with the STEAM Approach on Students' Spatial Abilities in Learning Geography

Muhammad Isna Qurrata Ayun[1], Chul-ki Cho[2], Thabile Zondi[3]
[1]Pendidikan Geografi, Universitas Sebelas Maret, Surakarta, Indonesia
[2]Kyungpook National University, Korea Selatan
[3]University of Kwa Zulu Natal, Afrika Selatan

Article Info

Article history:

Received Jul 22, 2023
Revised Jul 24, 2023
Accepted Jul 31, 2023

Keywords:

Art and Mathematics
Engineering
Flipped classroom
Science
Spatial ability
Technology

ABSTRACT

Purpose of the study: The purpose of this study was to determine the effect of the spatial abilities of students using the Flipped Classroom model with the Science, Technology, Engineering, Art and Mathematics learning approach using the expository model in class X.

Methodology: The method used is quasi-experimental with the Post Test Only Control Group Design research design. The population in this study were all class X at senior high school. Data collection techniques are carried out by observation, testing and documentation. The analysis test technique uses one-way Anava with a test with a level of 5%.

Main Findings: Based on the results of the analysis, it was concluded that there was a significant influence on the spatial abilities of students who used the Flipped Classroom model with the Science, Technology, Engineering, Art and Mathematics learning approach with the expository model in class

Novelty/Originality of this study: The novelty of this study can be seen from its aim to determine the effect of the spatial abilities of students who use the Flipped Classroom model with the Science, Technology, Engineering, Art and Mathematics learning approach with the expository model in class X. The limitation of this study is that it only measures the effect of the flipped classroom model using the STEAM approach.

Corresponding Author:
Muhammad Isna Qurrata Ayun,
Geography Education, Universitas Sebelas Maret, Kentingan, Jl. Ir Sutami No.36, Kec. Jebres, Kota Surakarta, Jawa Tengah 57126, Indonesia
Email: mhdisnaquray3@gmail.com

1. INTRODUCTION

According to Law Number 20 of 2003 concerning the National Education System Article 3, the aim of national education is to develop the potential of students to become human beings who believe and fear God Almighty, have noble character, are healthy, knowledgeable, capable, creative, independent, and become citizens of a democratic and responsible country. The stated educational goals are an integration between cognitive understanding and the application of a good attitude. Both of these are important points that have been included in 21st century learning skills.

21st century learning is a learning system that is influenced by the progress of human thought patterns [1], [2]. The 21st century learning system emerged as a result of a global movement calling for the opinion that formal education must be changed. Traditional approaches that emphasize memorization or the application of simple procedures will not develop students' critical thinking skills or independence. Learning with a traditional

approach is no longer in demand. The 21st century learning system emphasizes learning by using technology so as not to be left behind by others [3]–[5].

The link between the demands of professional teachers and the lack of implementation of learning using this technology is the main reason the authors made this research. Another problem is that students cannot maximize their understanding of the material presented by the teacher or teacher, due to the mismatch of the mentoring model applied by the teacher [6]–[8]. Teachers prefer to apply conventional methods and those that are commonly applied from previous learning activities. The problems above are problems faced by every subject universally, including geography subjects. Geography subjects in the 21st century emphasize more on the application of an independent mindset in finding material and place more emphasis on collaboration based on project-based learning that utilizes technological media.

The 21st century geography subject has a concentration on application in building students' critical thinking. This critical thinking related to geography gives strength in openly exploring geography studies. The ability to think critically in geography learning can run effectively when learning is supported by using technology. Based on the observation activities carried out at SMA N 1 Kartasura, it is known that a new breakthrough is needed in increasing critical thinking and other things that support the application of 21st century learning, namely using learning methods and approaches that can answer the challenges of the 21st century.

The Flipped Classroom model with a Science, Technology, Engineering, Art, and Mathematics (STEAM) approach is a combination that can captivate students' interest in studying geography. Because currently students prefer or are interested in things that are visual and digital. The Flipped Classroom model is a model that does not just learn using learning videos, but places more emphasis on how to use class time so that learning is of higher quality and can improve students' knowledge and critical thinking skills. The Flipped Classroom model and the STEAM approach provide a different learning technique for learning geography, in this activity students are brought into the digital world where there is a visualization to explain material using video education media to hone students' critical thinking skills and spatial thinking skills.

Related to visualization, geography is also a visual science that has applications in spatial understanding. Spatial understanding is an important feature in geography learning activities. The study of geographical phenomena does not only explain the existence of a phenomenon and the process by which this phenomenon occurs on the earth's surface, but also the shape, size, direction, pattern of the phenomenon and its relationship to other phenomena. The purpose of this study was to determine the effect of the spatial abilities of students using the Flipped Classroom model with the Science, Technology, Engineering, Art and Mathematics learning approach using the expository model in class X.

2. RESEARCH METHOD

The research method used in this study is a quasi-experimental research method. The experimental method is used to determine whether there is a causal relationship between the independent variables and the dependent variable by giving a treatment to the experimental group and holding a control group for comparison. The research design used was the Post test only control group design. The research design can be observed in the table below.

Table 1. Data on student learning outcomes in class two stay two stray

Group	Treatment	Post Test
Eksperiment 1	T1	P1
Eksperiment 2	T2	P2
Control	-	P3

Information:

T1 : Treatment of experimental group 1 with the Flipped Classroom learning model
T2 : Treatment of experimental group 2 with the Flipped Classroom learning model assisted by Science, Technology, Engineering, Art and Mathematics approaches (STEAM)
- : Control class no treatment
P1 : Post test in experimental group 1 (Model Flipped Classroom)
P2 : Post test in experimental group 2 (Model Flipped Classroom with STEAM approach)
P3 : Post test in the control group (Expository)

The population is defined as the group of subjects who wish to generalize the results of the research [7], [9], [10]. The population is all members of groups of humans, animals, events, objects that live together in one place and are planned to be the target of conclusions from the final results of a study [11], [12]. The population of this study was all class X at senior high school. The sample is a part that represents the population, which is

taken using certain techniques [13]–[15]. The sample in this study was class X A, X B, X C. The three classes were sampled due to the small population. This study uses a saturated sampling technique in which the entire population is used as a sample. Therefore, all class X at senir high school was used as a sample. Then random sampling was carried out to determine the experimental class I, experimental class II and control class.

The data collection technique used in this research is a test to measure the spatial ability of students and non-test in the form of observation to determine the learning process. Observation techniques are used to assess attitude competence in the learning process through discussion observations. The attitude assessment grid is shown in the table below.

Table 2. Attitude Assessment Grid

Observed Indicators	Number of Items	Item Number
Show Curiosity	1	1
Demonstrate a caring attitude towards the social environment	1	2
Carry out tasks honestly and responsibly	1	3
Total	3	

Skill competence is assessed by means of observation of presentation and delineation skills. The skills assessment grid is shown in the table below.

Table 3. Skill Assessment Grid

Observed Indicators	Number of Items	Item Number
Carry out Learning Assignments	1	1
Engage in problem solving	1	2
Ask other students or the teacher when you find something you don't understand	1	3
Trying to learn the subject matter, searching and taking notes		4
Carry out the learning process according to the teacher's instructions	1	5
Train yourself to answer questions from teachers and other students	1	6
Willingness, Enthusiasm and Enthusiasm in learning	1	7
Total	7	

Analysis of the data used in this study is to use descriptive statistical methods and inferential statistics. Descriptive statistical analysis is used to describe or provide an overview of data in the form of tables and graphs of the average value in order to easily obtain an overview of the nature or characteristics of objects from the data [16]–[18]. Inferential statistics are used for hypothesis testing. Testing the hypothesis in this study used one-way analysis of variance (one-way-anava) with a significance level of 5%. Analysis of variance (anava) aims to test whether or not there are differences in the effect of the new treatment (factor) there is a dependent variable. However, hypothesis testing can be done if the analysis requirements are met, namely the data is normally distributed and has homogeneity.

3. RESULTS AND DISCUSSION

3.1. RESULTS

Data collection on the ability to think spatially was obtained from 8 post-test questions that represented Spatial Ability indicators worked on by students. The value of spatial ability uses a scale of 1–100 in accordance with Permendikbud no 23 of 2016 concerning criteria regarding the scope, objectives, benefits, principles, mechanisms, procedures and instruments for assessing student learning outcomes. Experimental class 1 was treated with the Flipped Classroom model with a total of 35 students. Students carry out a post test after being treated for 3 (three) meetings with a time allocation of 3 x 45 minutes. Students are given 8 questions that reflect aspects of spatial ability. The following is the average aspect of the spatial ability of the Experiment 1 class.

Table 4. Mean Aspects of Spatial Ability of Experimental Class 1

Aspect of Spatial Ability	Question Number	Average	Completeness	Predicate
Comparation	1	95.96774	Complete	Very good
Aura	2	85.48387	Complete	Good
Region	3	72.58065	Not Completed	Not enough

Transition	4	63.70968	Not Completed	Not enough
Analogy	5	66.93548	Not Completed	Not enough
Hierarchy	6	47.58065	Not Completed	Not enough
Pattern	7	29.03226	Not Completed	Not enough
Association	8	36.29032	Not Completed	Not enough

The aspect of spatial ability that has the highest average value is Comparation with a value of 95.96, while the aspect with the lowest average is the Pattern aspect with a value of 29.03. These results describe that it is easier for students to solve problems with information in the form of images that visualize a theory compared to pictures that explain factual events. Based on data calculations, the average value of the spatial abilities of the Experiment 1 class is in the less category with an average of 62.19.

Experimental Class 2 was given the Flipped Classroom model treatment with the help of the Science, Technology, Engineering, Art and Mathematics (STEAM) learning approach and had a total number of students of 35 people. Students carry out a post test after being treated for 3 (three) meetings with a time allocation of 3 x 45 minutes. Students are given 8 questions that reflect aspects of spatial ability. The following is the average aspect of the spatial ability of the Experiment 2 class.

Table 5. Average aspects of the spatial ability of the experimental class 2

Aspect of Spatial Ability	Question Number	Average	Completeness	Predicate
Comparation	1	95.96	Complete	Very good
Aura	2	74.19	Not completed	Good
Region	3	79.03	Complete	Not enough
Transition	4	66.12	Not completed	Not enough
Analogy	5	65.32	Not Completed	Not enough
Hierarchy	6	45.16	Not Completed	Not enough
Pattern	7	46.77	Not Completed	Not enough
Association	8	62.09	Not Completed	Not enough

The aspect of spatial ability that has the highest average value is Comparation with a value of 95.96, while the aspect with the lowest average is the Hierarchy aspect with a value of 45.16. These results describe that it is easier for students to solve problems with information in the form of images that visualize a theory compared to pictures that explain factual events. Based on data calculations, the average value of the spatial abilities of the Experiment 2 class is in the less category with an average of 66.83.

The Expository Class acts as a control class consisting of 36 students. Students are given a post test after learning for 3 meetings with a time allocation of 3 x 45 minutes. Students are given 8 questions that reflect aspects of spatial ability. The following is the average aspect of spatial ability in the Expository class in the table below.

Table 6. Average aspects of the spatial ability of the experimental class 2

Aspect of Spatial Ability	Question Number	Average	Completeness	Predicate
Comparation	1	86.66	Not Completed	Not enough
Aura	2	45	Not Completed	Not enough
Region	3	48.33	Not Completed	Not enough
Transition	4	53.33	Not Completed	Not enough
Analogy	5	50	Not Completed	Not enough
Hierarchy	6	36.66	Not Completed	Not enough
Pattern	7	41.66	Not Completed	Not enough
Association	8	70	Not Completed	Not enough

The aspect of spatial ability that has the highest average value is Comparation with a value of 86.66, while the aspect with the lowest average is the Hierarchy aspect with a value of 36.66. These results describe that it is easier for students to solve problems with information in the form of images that visualize a theory compared to pictures that explain factual events. Based on data calculations, the average value of the spatial ability of the control class is in the less category with an average of 53.95.

Prior to testing the hypothesis, a prerequisite test was carried out in the form of homogeneity and normality of the data. Prerequisite test using daily repetition data. The data normality test is a prerequisite test that is carried out to find out if the research sample is normally distributed [6], [19], [20]. If a data is normally distributed, then the data is suitable for use as a sample. This normality test uses the Liliefors method with a significance level of 0.05%. The data normality test is shown in the table below.

Table 7. Results of the normality test for class X

Data	Class	L price		
		L_{count}	L_{table}	Conclusion
Daily tests	Control	-0.21181	0.886	Normal
	Eksperiment 1	-0.00445	0.886	
	Eksperiment 2	0.058601	0.886	
Posttest results	Control	0.069352	0.886	
	Eksperiment 1	0.172817	0.886	
	Eksperiment 2	0.14196	0.886	

Determination of data normality is done by matching the value of L count with L table, if L count < L table, then the data is normally distributed. Judging from these results, it is known that the ability of students in the initial conditions is normally distributed and the post-test results are also normally distributed. The data homogeneity test is the second prerequisite test that is carried out to find out whether the variant of the data to be treated comes from the same data or not. This study used the F test with a significance level of 5%. The results of the homogeneity test of daily repetitions and post tests can be seen in the table below.

Table 8. Homogeneity test results

Data	Class	L Price		
		L_{count}	L_{table}	Conclusion
Daily Tests	Control			Homogen
	Eksperiment 1	-332.75	1.766999	
	Eksperiment 2			
Posttrst result	Control			
	Eksperiment 1	-552.21	1.766999	
	Eksperimen 2			

Determination of homogeneity of data variance is done by comparing the calculated F value with F table, if F count < F table, then the data is normally distributed. Judging from these results, it is known that the data for daily repetition and post test are considered uniform. The hypothesis formulated is that there is an influence from the Flipped Classroom model with the Science, Technology, Engineering, Art and Mathematics (STEAM) learning approach on the Spatial Ability of students in class X IPS SMA N 1 Kartasura in 2020 in the material of the hydrological cycle and river flow patterns. After the homogeneity and normality prerequisite tests have been carried out, anava calculations can be carried out. The results of calculating the average difference with Anava can be done in the table below.

Table 9. Anava calculation results

Source of Variation	SS	df	F	P-value	F crit
Between Groups	28783.15	2	22.23367987	9.4E-09	3.084577
Within Groups	66670.58	103			
Total	95453.73	105			

Consolidation in this study, to find out whether there is influence/difference in the average of the three classes, it can be seen in the Fobs and Ftable tables. The Fobs obtained were 22.23367987 and Ftable with a significant level of 5% was 3.084577. Based on the results of anava, it is known that the value of Fobs > Ftable

this shows the result that Ho is rejected. This proves that there are differences in spatial abilities and is proven to have an influence from the application of the Flipped Classroom model with the STEAM learning approach.

3.2. DISCUSSION

This study involved 106 students in three classes who were treated with the Flipped Classroom model, the Flipped Classroom model with the STEAM and Expository approaches so as to have an effect in the form of different spatial abilities on the final result. Before being given treatment, the three classes had commensurate cognitive abilities as evidenced in the results of homogeneous and normal data. After being given treatment in the form of applying different learning models, it was found that the three classes had significantly different spatial ability values, this incident was the result of giving different learning models.

Experimental Class 2 with the Flipped Classroom model treatment with the Science, Technology, Engineering, Art and Mathematics (STEAM) learning approach obtained the highest average, in second place was occupied by Experiment 1 class with the Flipped Classroom model treatment, and the control class with the Expository model had the lowest score. The three classes are generally known to have different average spatial abilities, reinforced by the results of the Anava calculation which states that the first hypothesis is accepted with a Fobs value of 22.23367987 > Ftable 3.084577.

The three classes have a tendency to be in the form of a class treated with non-conventional models and media which has better spatial thinking values than the class with conventional models and media. The class with the expository model has the lowest score, the class with the model variation, namely Experiment 1, has a better value than the expository, and the class with the model variation and assisted by a learning approach, namely the Experiment 2 class, has a higher score than the experimental class 1. When describing each aspect, there are several anomalies that occur in several aspects. In the pattern aspect, the expository class has a better value than the Flipped Classroom. Some of the things that make the expository class have advantages in this aspect are none other than the synchronization between students' learning methods and the media used, the expository class places more emphasis on knowledge and understanding, so that the conventional method or direct elaboration has the carrying capacity to be able to better recall the material that was delivered.

In the association aspect, the expository class has more value than the Flipped Classroom class and the Flipped Classroom class with STEAM. In general, the three classes have a carrying capacity in the elaboration of material that can trigger the development of students' understanding of the material presented, but the expository class can package it using a more straightforward explanation, this is because the expository class carries out the elaboration of material face to face, so that the material presented can be processed by students better and can be recalled. In the Comparation aspect, the Flipped Classroom class and the Flipped Classroom class with STEAM have the same high score of 95.96 and only below it is the expository class with a value of 86.66. In the Region, Transition and Pattern aspects, the Flipped Classroom with STEAM has the same highest scores compared to the other classes, namely 79.03, 66.12 and 46.77. In the aspects of Aura, Analogy and Hierarchy, the Flipped Classroom class has the same highest scores compared to the other classes, namely 85.48, 66.93 and 47.58.

These results explain that the use of the Flipped Classroom model increases the curiosity of students and provides a learning concept that collaborates learning with a live style of students, namely mobile learning. The most striking difference between the two treatments is that the technical part summarizes the observations. Flipped Classroom which is applied to Experiment 1 class uses the usual summarization method, namely by making writing on a piece of paper and collecting it on the last day before doing the post test, while what is applied in Experiment 2 class is the Flipped Classroom model with STEAM, the treatment is summarizing by calling participants students to make a video project and then the video is uploaded on their own class's YouTube channel under the name Social Three. Both of these treatments were equally successful in terms of comparison, Aura, Region, Transition, Analogy, Hierarchy, and Pattern.

The Flipped Classroom learning model has an impact on aspects of the attitudes and skills of students. The Flipped Classroom model class has the ability to deliver presentations that are more open and have a perspective, this is because students' understanding is more personality and not a text book. The presentations made stimulated students' critical thinking and made the learning process collaborative. Learners with the Flipped Classroom model explore their experiences in communicating more. The teacher gives a reward for students who can provide an attractive product and appearance, the aim is to trigger students' interest in analytical activities. The superiority of the Flipped Classroom model class is evidenced by the mean value of attitude of 80.2380952 and skills of 83.06122449. While the Expository class has a value of 68.055556 in the attitude aspect and 67.65873016 in the skill aspect.

Previous research conducted by [21] can be concluded that there are significant influences and differences by using the flipped classroom model based on the STEAM approach in online mode to improve students' conceptual mastery and interpersonal intelligence. Meanwhile, in this updated research it can be seen clearly that the application of the Flipped Classroom model and the use of STEAM has a large influence on students' spatial abilities compared to the conventional method or the application of the Expository model. The

application of the Flipped Classroom model is a different model and can provide a foundation for students to open their minds to the material to be discussed, while the STEAM approach is a stimulus that triggers students to do deeper research regarding the material. These two things are a good combination and have a positive impact on SMA N 1 Kartasura.

4. CONCLUSION

Based on the results of the research and discussion that have been presented in CHAPTER IV, it can be formulated that the conclusion is that there is a significant influence on the application of the Flipped Classroom model with Science, Technology, Engineering, Art and Mathematics (STEAM) and the Expository model on Spatial Ability in class X at senior high school. This research has several deficiencies in its implementation, because researchers provide suggestions that more in-depth studies are needed in subsequent research, especially on the Flipped Classroom model and the STEAM approach. The application of the STEAM learning approach still needs to be redeveloped, due to its broader and more complex scope for geography learning.

ACKNOWLEDGEMENTS

The researcher would like to thank the research colleagues and all parties involved in this research. The researcher also apologizes if there are still errors or deficiencies in this article, the researcher hopes for further research to be even more innovative. In addition, the researcher also hopes that this research can be useful for all who read it

REFERENCES

[1] D. Darmaji, A. Astalini, D. A. Kurniawan, and F. T. Aldila, "Students' Perceptions in the use of web-based character assessment: A view from gender perspective," *J. Pendidik. Progresif*, vol. 11, no. 2, pp. 362–383, 2021, doi: 10.23960/jpp.v.

[2] Asrial, Syahrial, D. A. Kurniawan, F. T. Aldila, and M. Iqbal, "Implementation of web-based character assessment on students' character outcomes: A review on perception and gender," *J. Technol. Sci. Educ.*, vol. 13, no. 1, pp. 301–328, 2023, doi: 10.29333/iji.2022.15418a.

[3] D. Darmaji, A. Astalini, D. A. Kurniawan, F. T. Aldila, and H. Pathoni, "Gender and Perception: Implementation of web-based character assessment in science learning," *J. Educ. Res. Eval.*, vol. 6, no. 1, pp. 131–142, 2022, doi: 10.23887/jere.v6i1.37737.

[4] A. Sanova, A. Bakar, A. Afrida, D. A. Kurniawan, and F. T. Aldila, "Digital literacy on the use of e-module towards students' self-directed learning on learning process and outcomes evaluation Cources," *JPI (Jurnal Pendidik. Indones.*, vol. 11, no. 1, pp. 154–164, 2022, doi: 10.23887/jpi-undiksha.v11i1.36509.

[5] A. Asrial, S. Syahrial, D. A. Kurniawan, F. T. Aldila, and M. Iqbal, "Gender and Perception: Implementation of web-based character assessment on students' character outcomes," *Int. J. Instr.*, vol. 15, no. 4, pp. 311–338, 2022, doi: 10.29333/iji.2022.15418a.

[6] F. T. Aldila, E. F. S. Rini, S. W. Oktavia, N. N. Qoidah, F. P. Sinaga, and N. Septiani, "The relationship of teacher teaching skills and learning interests of physics students of senior high school," *Edufisika J. Pendidik. Fis.*, vol. 8, no. 1, pp. 101–105, 2023, doi: 10.59052/edufisika.v8i1.24864.

[7] S. Mundarti and F. T. Aldila, "Affective assessment instrument based on krathwohl-anderson taxonomy in senior high school," *J. Eval. Educ.*, vol. 4, no. 2, pp. 74–79, 2023, doi: 10.37251/jee.v4i2.323.

[8] F. P. Sinaga, Jurhana, Yusrita, and M. Hidayat, "Analisis penggunaan metode mengajar (metode demonstrasi, metode eksperimen, metode inquiry, dan metode discovery di SMA Negeri 11 Kota Jambi)," *Relativ. J. Ris. Inov. Pembelajaran Fis.*, vol. 5, no. 2, pp. 103–110, 2022, doi: https://doi.org/10.29103/relativitas.v5i2.7830.

[9] R. Fitriani *et al.*, "Analisis karakter kerja keras siswa kelas XI IPA di SMAN 1 Kota Jambi," *PENDIPA J. Sci. Educ.*, vol. 5, no. 2, pp. 188–194, 2021, doi: 10.33369/pendipa.5.2.188-194.

[10] W. A. Putri, R. Fitrini, E. F. S. Rini, F. T. Aldila, and T. Ratnawati, "Pengaruh motivasi terhadap hasil belajar siswa IPA di SMAN 6 Muaro Jambi," *SAP (Susunan Artik. Pendidikan)*, vol. 5, no. 3, 2021.

[11] F. T. Aldila, R. P. W. Yuda, M. Wulandari, and A. P. Ningsi, "Deskripsi keterampilan proses sains siswa SMAN 10 Muaro Jambi pada materi kesetimbangan pada tali," *J. Pendidik. Fis.*, vol. 9, no. 2, pp. 112–119, 2020.

[12] F. T. Aldila and E. F. S. Rini, "Teacher's strategy in developing practical values of the 5th pancasila preepts in thematic learning in elementary school," *J. Basic Educ. Res.*, vol. 4, no. 1, 2023.

[13] F. T. Aldila, D. Darmaji, and D. A. Kurniawan, "Analisis respon pengguna terhadap penerapan web-based assessment pada penilaian sikap siswa terhadap mata pelajaran IPA dan nilai-nilai pendidikan karakter," *Edukatif J. Ilmu Pendidik.*, vol. 4, no. 1, pp. 1253–1262, 2022, doi: https://doi.org/10.31004/edukatif.v4i1.2091.

[14] N. N. Simamora, W. A. Putri, M. Iqbal, A. Ramadhanti, and E. F. S. Rini, "Description of student discipline attitudes at SMP Negeri 16 Jambi City," *Lensa J. Kependidikan Fis.*, vol. 8, no. 2, p. 76, 2020, doi: 10.33394/j-lkf.v8i2.3175.

[15] A. Ramadhanti, K. Kholilah, R. Fitriani, E. F. S. Rini, and M. R. Pratiwi, "Hubungan Motivasi terhadap hasil belajar fisika kelas X MIPA di SMAN 1 Kota Jambi," *J. Eval. Educ.*, vol. 3, no. 2, pp. 60–65, 2022.

[16] M. Wulandari, R. P. Wirayuda, F. Aldila, and R. Wulandari, "Description of students' integrated science process skills on friction material on a flat field," *Lensa J. Kependidikan Fis.*, vol. 8, no. 2, pp. 93–103, 2020, doi: 10.33394/j-lkf.v8i2.3206.

[17] M. Iqbal, A. A. B. Ginting, F. T. Aldila, W. A. Putri, S. Maryani, and T. Ratnawati, "Hubungan persepsi siswa dalam

penggunaan web-based assessment dengan karakter siswa di SMPN 2 Batanghari," *J. Pendidik. Edutama*, vol. 9, no. 1, pp. 51–60, 2022.

[18] F. T. Aldila, M. M. Matondang, and L. Wicaksono, "Identifikasi minat belajar siswa terhadap mata pelajaran fisika di SMAN 1 Muaro Jambi," *J. Sci. Educ. Pract.*, vol. 4, no. 2, pp. 22–31, 2020.

[19] S. R. Putri and Syafriani, "Pengembangan E-Modul Fisika Berbasis SETS (Science, Environment, Techonogy, Society) untuk meningkatkan kemampuan berpikir kritis peserta didik SMA/MA," *J. Penelit. Pembelajaran Fis.*, vol. 8, no. 2, pp. 142–151, 2022, doi: https://doi.org/10.24036/jppf.v8i2.119361.

[20] Y. I. Suhara, N. D. Kiska, and F. T. Aldila, "Hubungan karakter gemar membaca terhadap hasil belajar tematik peserta didik Sekolah Dasar," *Integr. Sci. Educ. J.*, vol. 3, no. 1, pp. 11–15, 2022, doi: 10.37251/isej.v3i1.182.

[21] J. Albar, S. Wardani, and S. Sarwi, "The effect of flipped classroom based STEAM approach on mastery of concepts and interpersonal intelligence in online learning," *J. Prim. Educ.*, vol. 10, no. 2, pp. 129–140, 2021, doi: https://doi.org/10.15294/jpe.v10i1.47301.