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IMPLEMENTATION OF THE SCIENCE E-MODULE BASED ON GUIDED INQUIRY WITH THE FLIPPED CLASSROOM STRATEGY TO IMPROVE STUDENTS SCIENCE PROCESS SKILLS

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Abstract: This study aims to determine the influence of implementing a science e-module based on guided inquiry with the flipped classroom strategy to improve junior high school students' science process skills. The research used is pre-experimental with one group pretest-posttest research design to determine the improvement of students' science process skills in one group without any comparison group. The research sample is grade eight junior high school students at SMP Gresik, Indonesia, with a total of 30 students that consist of 15 males and 15 females. The research instruments used are tests (pretest-posttest), observation (students' activity sheets), and survey (students' response questionnaire). The data collection techniques used are written, observation, and survey methods. The results of the tests are analyzed using the N-Gain calculation, which obtained 0.66, which is included in the medium category. The result of the observational analysis towards the improvement of science process skills has a very good category with a percentage of 94.8%. Meanwhile, the student response survey analysis has an average presentation of 96.7% in the very good category. The results of this study indicate that implementing a science e-module based on guided inquiry with the flipped classroom strategy can effectively improve junior high school students' science process skills.

Keywords: *Science E-Module Based on Guided Inquiry, Science Process Skills, Flipped Classroom*

INTRODUCTION

Science learning has characteristics that can develop students' science process skills and can stimulate student creativity [1]. In science learning, some activities focus on the learning process with direct experience [2]. Science process skills have shared types that can be developed in students. Types of science process skills for the junior high school level are basic processes with six aspects: observation, classifying, predicting, measuring, concluding, and communicating [3].

Schools' science learning uses only teachers' books during the learning process. It impacts the limited information obtained by students so that they cannot help students understand science material, as for other sources that teachers can apply to support the learning process, one of which is the module [4]. Research modules can supplement learning resources for students, which are expected when using modules to facilitate learning in the classroom or independently [5].

Based on an interview with one of the science teachers at a junior high school in Gresik and the research that has been carried out, the science learning method that is often used is lectures [6]. Lecture learning is easy for teachers because they do not need special tools and activity designs. Teachers can fully control the class and deliver the material broadly and clearly. However, this method makes students passive and bored, so it is still not optimal in improving students' thinking skills and activeness, which impacts low science process skills [7]. Meanwhile, the teaching materials used are teacher and student handbooks. In contrast, the features contained in the books to guide students to carry out activities that can develop thinking skills are not well applied by teachers in learning activities due to the absence of laboratories and lab tools.

Based on the interviews and other previous research [8], it is said that teachers still develop low science process skills for students in science learning, especially in the vibrational materials. Students are less able to solve problems, as evidenced by the students' low scores every year. Based on this, it shows the need for efforts to realize science learning that can develop students' thinking skills. It is necessary to apply teaching materials in the form of modules that suit student needs in electronic modules.

The electronic-based module applied to this study has self-instructional characteristics, which means that there is only one material charge, namely vibration matter. Self-contained, which means all the components of the material are in the module. Stand-alone means that modules can be accessed or used alone and do not depend on other media. User Friendly means easy to use and adaptive, so it is not difficult because it is adjusted to the character of students [9]. In its use, the e-module can be accessed anywhere and anytime offline [10]. It makes it easier for students and teachers to carry out learning activities in different places. In addition, this e-module contains experimental activities that use simple tools that can be made and practiced by yourself at home, with these learning activities not constrained by limited practicum tools.

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Regarding improving the science process's skills, one of the important aspects is the selection of learning models. Therefore, the learning model applied is guided inquiry because the stages of learning are effective in training students to improve science process skills [11]. The research explained that guided inquiry is effective as a facility to train students' science process skills through learning stages consisting of observing, formulating problems, making hypotheses, designing experiments, conducting experiments, and collecting and analyzing data [12]. Based on these learning stages, the guided inquiry learning model is suitable for improving science process skills because the learning stage provides opportunities for students to be active such as in experimental activities. This statement is supported by existing research [13], explaining that science process skills can be obtained and developed with students involved in scientific activities. In the guided inquiry learning model, students are required to conduct investigations that have the potential to increase the ability of science process skills.

This research applies the flipped classroom strategy as a learning innovation aiming to improve learning time efficiency, student engagement, and interaction between students and teachers. Flipped classrooms can increase self-regulated learning or independent learning of students. With the increase in self-learning, students are considered ready when they will receive learning in the classroom [14]. Flipped classroom strategy forms students more ready to accept the subject matter when in class because students are required to have initial knowledge before learning begins [15]. Based on this description, research was carried out by applying a guided inquiry-based science E-module on vibration material at a junior high school in Gresik, aiming to improve students' science process skills.

RESEARCH METHODS

The type of research used is pre-experimental with the One Group Pretest-Posttest Design research design to determine the improvement of students' science process skills in one group only without a comparison group. The subject of this study was a guided inquiry-based science electronic module with a flipped classroom strategy to improve the science process skills of junior high school students on vibrational material. It was tested on grade eight students at Gresik Junior High School, which totaled 30 students, consisting of 15 students and 15 female students.

The e-modules used have been validated from research developed using a research and development method approach (Research and Development) with the flow of research: 1. Knowing the potential and problems, 2. Data collection, 3. Compiling product designs, 4. Product validation, 5. Product revision, and 6. Limited trials. The validation results are shown in the following Table 1.

Table 1. E-module validation results

Component	Percentage	Criteria
Content	97 %	Very valid
Language	100 %	Very valid
Presenting	98 %	Very valid

Instruments

The instruments in this study consisted of tests (Pretest-Posttest), observation (student activity sheets), and surveys (student response questionnaires). The test instrument contains 10 vibrational material essay questions with the cognitive realm of C4. The test aims to know the student's ability to solve science process skills-based questions. The results of the student's written test can be seen through the score obtained by the student, which is a maximum score of 100.

Table 2. Student science process skills test indicators

Indicators	Question number
Observe	1,2
Formulating the problem	3,4
Drawing up hypotheses	5,6
Interpret data	7,8
Conclude	9,10

The test validity test using Pearson's Product Moment correlation technique resulted in a rcount > rtable at a significance level of 0.05, which was declared valid. The reliability test was carried out with alpha Cronbach analysis and obtained a significance value of 0.649. The value of $\alpha > 0.6$ concluded that the test instrument was reliable.

The observation instrument contains an assessment of student activities based on aspects of science process skills with a score of 1 to 4 points. Science process skills include making observations, conducting experiments, interpreting data, concluding, and communicating results. The survey instrument is in the form of a student response questionnaire that has 17 points of statements. The available answer choices are yes and do not match Guttaman's assessment criteria.

The data collection techniques used are test, observation, and survey methods. The test aims to measure student learning outcomes and science process skills before and after applying the electronic science module. Observation determines and measures the practicality of applying the Science E-module to learning activities. Questionnaires are given to find students' responses after using the science E-module as teaching material during learning on vibration material.

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Data Analysis

The data analysis techniques used in this study are as follows:

1. Analysis of learning outcomes

It can be known by using the gain score formula by calculating the average post-test score minus the average pre-test score divided by the maximum value minus the average pre-test score to determine the improvement in learning outcomes. Three categories of numerical score gains are shown in Table 3.

Table 3. Numbered Score Gain Criteria

Score	Criteria
(<g>) > 0.7	High
0.7>(<g>)>0.3	Medium
(<g>)<0.3	Low

2. Observation analysis of learners' science process skills

An observation sheet for science process skills is used to determine students' science process skill value. In this observation sheet, a range of values ranging from 1 to 4 points are used as a measure of the level of science process skills contained in the science E-module. The indicators of assessment of science process skills used can be seen in Table 4.

Table 4. Indicators of science process skills

Indicators	Assessment
Make observations	Observation
Drawing up hypotheses	Observation
Measure	Observation
Interpreting data	Observation
Conclude	Observation
Communicating results	Observation

The percentage value of science process skills is calculated using the equation of the number of scores obtained divided by the maximum number of scores, then multiplied by 100%. The criteria for students' science process skills after using the Science E-module by applying a guided inquiry learning model are grouped into five categories [16].

Table 5. Activity criteria Science process skills

Percentage of activity (%)	Criteria
81 – 100	Very well
61 – 80	Good
41 – 60	Enough
21 – 40	Less
0 – 20	Very lacking

3. Learner Response Analysis

Analysis of learners' responses was analyzed using the Guttaman scale expressed in the form of a question. The results of the completed questionnaire are then calculated according to the following criteria:

Table 6. Guttaman score criteria

Choice/Answer	Score
Yes	1
No	0

How to find out the response by using the percentage of each choice of statements calculated by the equation formula the number of learners answering yes divided by the sum of all learners then multiplied by 100%

The criteria for interpretation of the learner's response score, namely:

Table 7. Learner response score interpretation criteria

Percentage (%)	Criteria
0 - 20	Very lacking
21-40	Less
41-60	Enough
61-80	Good
81-100	Very well

If the percentage of the learner's response ≥81%, then it means that the learner responds well to the learning model applied [17].

RESULTS AND DISCUSSION

This study used an electronic module as additional teaching material for students by applying a guided inquiry learning model and a flipped classroom strategy that contained vibration material in class VIII-A, which amounted to 30 students and lasted for three days. Here is a summary of research activities that have been carried out:

a. The first day, a pre-test was carried out to measure the ability of students' science process skills before the implementation of the electronic science module
b. The second day carried out three face-to-face learning in the sub-section of the class VIII vibration material for the even semester. This learning applies the flipped classroom strategy so that before learning in class through the WhatsApp group, researchers provide information and teaching materials related to vibration material to students to learn independently at home. The following is

a summary of the guided inquiry learning process by applying electronic modules:

Filling Student worksheet

In this activity, students in groups work on activities in the E-module by applying a guided inquiry model, namely making observations related to a problem presented, compiling hypotheses, and compiling problem formulations.

Figure 1. Students make problem formulations and construct hypotheses

Measuring

In this activity, students conduct experiments according to the stages of the experiment in the module and then interpret the data of the experimental results.

Figure 2. Students perform pendulum experiments

Communicate results

In this activity, students present the results of the data and conclusions obtained after conducting the experiment.

Figure 3. Students present the results of the experiment

Science process skills

Process skills data are obtained from cognitive test sheets in the form of pre-tests and post-tests, as well as observations of science process skills activities and students carried out during learning. Furthermore, the data were analyzed based on the achievement of classical science process skills and every aspect and improvement of science process skills obtained through signification and the category of improvement using the N-gain score on a classical scale and every aspect.

1. Cognitive Test Results Science process skills

Cognitive tests of science process skills are carried out before and after the application of the science e-module with a guided inquiry learning model in the form of pre-test and post-test. The following can be seen as the results of descriptive statistical analysis using the SPSS v.25 application, namely:

Table 8. Descriptive statistical results

Descriptive Statistics	Scores	
	Pre-test	Post-test
N	30	30
Range	35	30
Minimum	40	70
Maximum	75	100
Std. Deviation	9.523	8.039
Median	57.50	85.00
Modus	65	85
Variance	90.690	64.626
Mean	57.00	84.83

Table 8 shows that the test was followed by 30 students who obtained minimal score results when the pre-test was 40, and the post-test was 70. Then the maximum score of students during the pre-test is 80, and the post-test is 100. Furthermore, the Standard Deviation value at the pre-test is 9,523 while the post-test is 8,039. While the mean value on the pre-test is 57.00, and in the post-test, it is 84.83. Based on these results, it can be seen that there is a classical increase in the mean pre-test and post-test science process skill values in each student.

The recapitulation of the science process skill completion value of students of cognitive test results is stated in Table 9.

Table 9. Student science process skill completion score

Scores	Pre-test		Post-test		Category
	Number of students	Percentage (%)	Number of students	Percentage (%)	
>70	4	13	30	100	Complete
<70	26	87	0	0	Incomplete

Description: Minimum Completion Criteria (MCC) is 70

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Table 9 shows that out of 30 students who took the pre-test, as many as 13% or four students obtained a minimim completeness criteria score based on the provisions of the school 70. Meanwhile, 87% or 26 students get less than minimum completeness criteria scores. Meanwhile, the results of the post-test scores showed differently; namely, as many as 100% or 30 students got the complete category of minimum completeness criteria scores.

Before learning, students are given facilities in the form of an electronic science module in which there is material about vibrations, student activities, learning videos, and quizzes. Students are given a briefing to study the electronic module in advance so that students have preliminary knowledge of the material to be studied when in class. This is aimed at utilizing the existing time while still maintaining the quality of student learning, so in this study, a flipped classroom strategy was applied. It is one way to minimize direct instruction by teachers so as to increase interaction between students and teachers. In addition to that, the learning time in class becomes efficient so that learning is of higher quality [18].

Students' pre-test and post-test scores were also analyzed according to the achievement of each aspect of science process skill shown in Table 10.

Table 10. The achievement of students' science process skills in every aspect

Science process skills Indicators	achievement			
	Pre-test (%)	Category	Post-test (%)	Category
Observe	69.0	Good	90.0	Very well
Formulating the problem	67.5	Good	87.5	Very well
Structuring Hypotheses	60.0	Enough	86.7	Very well
Interpreting the Data	27.5	Less	70.8	Good
Conclude	61.0	Good	89.2	Very well
Average	57.00	Enough	84.83	Very well

Table 10 shows that the achievement of the highest aspect in the pre-test results is the observing indicator, which is 69.0%, while the lowest achievement obtained by the indicator interprets the data, which is 27.5%. Similar to the pre-test results, the highest aspect achievement in the post-test results is the observing indicator, which is 90.0%, while the lowest achievement is obtained by the indicator interpreting the data, which is 70.8%. Although the highest and lowest indicators in cognitive test results are the same, there is an increase in the average percentage.

2. Results of Observation of Student Skill Activities

In addition to the results of cognitive test scores, the science process skill of students is also observed through observation of science process skills activities during learning. The observation of the activity of science process skills is analyzed by referring to each aspect of science process skills which can be seen in Table 11.

Table 11. The average achievement of students' science process skill activity scores

Indicators	Achievement (%)	Criteria
Observation	95.8	Excellent
Measure	95.1	Excellent
Structuring Hypotheses	94.4	Excellent
Interpreting the Data	92.4	Excellent
Conclude	96.5	Excellent
Communicating results	94.5	Excellent
Average	94.8	Excellent

Table 11 shows the overall achievement of the average science process skill activity score of students in each aspect got a percentage of 94.8%, which is categorized as very good. The highest percentage of achievement, 96.5%, is found in the concluding indicator. Meanwhile, the lowest achievement of 92.4% is found in the indicator interpreting the data. According to the results of the existing percentage, it is in accordance with the science process skill test scores that show the most achievement in the indicator interpreting the data, which is 70.8%.

Science process skills improvement

Increased science process skills of students after the implementation of electronic modules with the application of guided inquiry learning models and flipped classroom strategies

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on vibrational materials. This is evident in the presence of paired t-test results against pre-test and post-test test scores of science process skills. Before that, a normality test was carried out a determinant if the data obtained was normally distributed. The results get a significant level of >0.05, which means that the existing data is normally distributed. Then, a paired t-test was performed using SPSS v.25. The following are presented the results in the following Table 12.

Table 12. Paired t-Test Results

	Mean	t	df	Sig. (p)
Pretest-Posttest	-27.8333	-18.203	29	0.000

Table 12 shows that the t-test was performed using SPSS v.25, the signification level (a) =5%. The results show that if the signification value is 0.000<0.05 so that H0 is rejected and Ha is accepted [19], so it can be said that there is a significant difference between the pre-test and post-test values of science process skills.

In addition, to find out the category of science process, skill improvement can be obtained through the N-Gain score. The N-Gain test score for each student's science process skill increase was obtained, and the average gain index <g> was 0.66, which is included in the moderate category. In the learning that was attended by 30 students, as many as 46.7% or 14 students experienced an increase in science process skill with high categories, as many as 50.0% or 15 students experienced an increase in moderate categories, and 3.3% or one student experienced an increase in low categories.

Learner Responses

The response questionnaire is a response and input by students to the implementation of learning in class VIII-A using a guided inquiry-based science e-module with flipped classroom strategies on vibration material. The following is presented a table of the average percentage of student responses answering "Yes" to the positive statements given on the student response questionnaire after learning.

In Table 13, the average percentage of student responses answering "Yes" to a positive statement in student response questionnaires was 96.7%, which had excellent criteria. All students of junior high school in Gresik, totaling 30 students' feel motivated and do not feel burdened by the existence of the electronic science module, and the learning model applied. This is known from the percentage of statements that electronic modules can motivate learning science and do not feel burdened by the existence of e-modules by obtaining an average percentage of 93.3% and 96.7%. Students assume that during learning, this electronic module is able to provide knowledge on the vibration material more broadly and encourage students to play an active role during the learning process. This is shown from the percentage statement that e-modules can make students feel curious and increase knowledge of vibrational materials, and students are active in the learning process who get a percentage with excellent criteria. In addition, students also think that the learning process applied can improve science process skills during learning, such as observation skills, making problem formulations, compiling hypotheses, experimenting, making conclusions, and communicating results. The statement refers to the average percentage of learner response questionnaires in statements number 6 to 17 that get excellent criteria.

Based on the presentation of the results above, table 7 shows the occurrence of improved science process skills, as evidenced in the student's cognitive test scores, namely the average percentage of pre-test and post-test, classically obtained a value of 57.00 while on the average post-test a score of 84.83 was obtained. In the cognitive test questions on science process skills, participants were given questions that required students to be able to hypothesize and think abstractly. In accordance with the cognitive theory by jean Piaget who posits that the cognitive abilities of students at the junior high school level are in the formal operational stage, at this stage, students are able to carry out systematic calculations, abstraction thinking, creative thinking, and concrete experiences [20].

In addition, the results of the activity of science process skills during the overall learning have an average achievement in each aspect of science process skill is 94.8% which is categorized as excellent. The indicator concluded that it got the highest achievement score, which is an average of 96.5%, thanks to the excellent category. An example of the concluding activity is that students are asked to make a conclusion from the results of a simple pendulum experiment, namely the relationship between the length of the rope and the magnitude of the frequency and period of vibration. Meanwhile, the lowest achievement is found in the indicator interpreting the data at 92.4%. These results are in accordance with the science process skill cognitive test scores, which show the lowest achievement found in the indicator interpreting the data at 70.8%. In the two results of the analysis, it can be seen that students are less able to analyze experimental data and connect the data to each other and expose the data into simpler statements, for example, in the form of graphs and tables. Because in the science process, skill test questions indicators interpret the data, students are asked to analyze a problem related to vibration and analyze a graph and table to

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determine the relationship between the frequency and period of a vibration which aims to expand the student experience in order to develop the knowledge gained. In line with the opinion [3] that in science, expanding learning through experience can be obtained through the application of basic science process skills because starting from a simple idea, students can develop it into new and complex ideas.

Table 13. The average percentage of student response questionnaire responses

No	Assessment aspects	Number of answers Yes	Percentage (%) Average	Criteria
1	Electronic modules can motivate learning science	28	93.3	Excellent
2	You don't feel burdened using electronic modules	29	96.7	Excellent
3	This electronic module can increase knowledge related to vibration materials	28	93.3	Excellent
4	This electronic module can make you take an active role in the learning process	29	96.7	Excellent
5	This electronic module can make you more curious about vibrational materials	28	93.3	Excellent
6	This electronic module can help you in connecting materials with everyday life	29	96.7	Excellent
7	The presentation of phenomena in the applied electronic modules is contained in everyday life	30	100	Excellent
8	This electronic module can help you solve problems scientifically	28	93.3	Excellent
9	This electronic module helps you in scientifically designing experiments	30	100	Excellent
10	This electronic module helps you scientifically infer data	28	93.3	Excellent
11	This electronic module helps you communicate scientific data	29	96.7	Excellent
12	The language inside the electronic module is clear and easy to understand	29	96.7	Excellent
13	Images, video, audio, and animation in this electronic module provide ease in understanding the material	29	96.7	Excellent
14	This electronic module can help you in working individually or in groups	29	96.7	Excellent
15	"Application of Concepts" that are in the electronic module according to the material studied	30	100	Excellent
16	You feel happy when learning to use electronic modules and applied learning models	30	100	Excellent
17	Applied electronic modules can improve your skills in learning science	30	100	Excellent
	Average		96.7	Excellent

Based on the scores of students' cognitive tests and the scores of the results of observations of student activities during learning, it can be said that there is an increase in student science process skills on vibrational material. The improvement of science process skills is influenced by the application of guided inquiry-based e-modules, which is evident from the achievement of each aspect of science process skill on the overall cognitive value has increased, as shown in Table 10. This is influenced by the learning stages in the guided inquiry, which spurs active student involvement during learning in activities such as determining problem formulation, compiling hypotheses, conducting experiments, interpreting, making conclusions, and communicating the results of experiments, with these activities being able to train science process, skill students. Research-guided inquiry makes students more active during the learning process who not only receive knowledge and just hear explanations from the teacher, but students gain knowledge with direct experience [12]. The improvement of science process skills is also influenced by the application of flipped classroom strategies which make the explanation time from the teacher less because previously students have studied the material to be taught at home so that the interaction between students and

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teachers is more and the activeness of students who are able to practice thinking skills during learning is more improved. The flipped classroom strategy realizes that students are better prepared to receive material when the class takes place because students are required to have initial knowledge before learning begins [15].

The increase in science process skills of students was also evidenced by the existence of a response questionnaire that showed an average percentage of "yes" answers of 96.7%, with excellent categories. Based on this, most students think that learning using an electronic module of science based on guided inquiry on vibration material can increase students' ability to carry out scientific activities that make students active so that they are able to develop student science process skills [21].

Based on the results of the N-Gain score, the increase in science process skill obtained a score of 0.66, thanks to the moderate category. This can be caused by the unfamiliarity of students practicing learning science process skills because they have never been trained in science process skills to students [22]. This is evidenced by the pre-test value, which shows that the science process skill achievement of students is categorized as sufficient before the inquiry-based science electronic module is guided. Science process skills can be mastered by learners if the aspects in them are taught repeatedly on an ongoing basis, which can make students accustomed to applying them. It is very necessary to repeat or practice habituation because the relationship between motivation and response will closely go if used frequently, and vice versa will decrease or disappear if rarely or never used [23].

Based on the various things that have been described, the conclusion that can be conveyed is that the increase in the science process skills of students after the implementation of the inquiry-based science electronic module is guided by a flipped classroom strategy on vibrational materials. The improvement of science process skills can be carried out with guided inquiry that invites students to find and understand concepts [12]. As well as the application of e-modules to become a medium for achieving the improvement of science process skills because the convenience and material in it can arouse the attention of students. The electronic module is an innovative device that can influence the increase in interest and motivation of learning students [24].

CONCLUSION

There was a significant increase in the science process skill of eight-grade students at junior high school in Gresik after the implementation of a guided inquiry-based science electronic module with a flipped classroom strategy on vibration material, namely the average percentage of pre-test scores of 57.00% to 84.83% on the average post-test value. The improvement of students' science process skills has an N-Gain index score of 0.66, thanks to the moderate category. This can be due to the unfamiliarity of students practicing learning science process skills. Based on this, to improve science process skills in students in science learning, it is necessary to be trained repeatedly and continuously with additional teaching materials in the form of guided inquiry-based science e-modules with flipped classroom strategies. After the implementation of this research, the suggestions that can be submitted are. The application of a guided inquiry learning model to improve science process skills should be carried out for a relatively long time because students are not used to scientific activities. So, researchers should then manage time better for the learning process to run effectively. Before class learning, researchers should have shared a list of student groups for experimental activities so that it does not take a long time when dividing groups. It is necessary to pay attention to the readiness of the media and equipment needed for learning to take place optimally.

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REFERENCES

[1] Sulthon, S. (2017). Pembelajaran IPA Yang Efektif dan Menyenangkan Bagi Siswa Madrasah Ibtidaiyah (MI). *ELEMENTARY: Islamic Teacher Journal*, *4*(1).

[2] Lestari, S. N. A. P. A., Jayadinata, A. K., & Aeni, A. N. (2017). Meningkatkan keterampilan proses sains siswa pada materi sifat-sifat cahaya melalui pembelajaran inkuiri. *Jurnal Pena Ilmiah*, *2*(1), 621-630.

[3] Rose Amnah, A. R., Mohamad Sattar, R., Azlin Norhaini, M., Zarina, O., & Lyndon, N. (2013). Inculcation of Science Process Skills in a Science Class. *Asian Social Science*, *9*(3), 47-57.

ISSN 1907-1744 (Cetak)
ISSN 2460-1500 (Online)

[4] Setyawan, D. N., & Wijayanti, A. (2020). Analisis Kebutuhan Buku Ajar Pendamping IPA Terpadu Berbasis Tri Nga (Ngerti, Ngrasa, Nglakoni) untuk Siswa SMP di Masa Pandemi Covid-19. *Wacana Akademika: Majalah Ilmiah Kependidikan*, *4*(2), 171-177.

[5] Herawati, N. S., & Muhtadi, A. (2018). Pengembangan modul elektronik (e-modul) interaktif pada mata pelajaran Kimia kelas XI SMA. *Jurnal inovasi teknologi pendidikan*, *5*(2), 180-191.

[6] Rohmah, I. L., & Hidayati, S. N. (2021). Analisis literasi sains peserta didik SMPN 1 Gresik. *PENSA: E-Jurnal Pendidikan Sains*, *9*(3), 363-369.

[7] Sulandari, S. Analisis terhadap Metoda Pembelajaran Klasikal dan Metoda Pembelajaran E-Learning di Lingkungan Badiklat Kemhan. *Jurnal Pendidikan Indonesia*, *1*(2), 176-187.

[8] Awalia, D. H., Setiadi, D., & Kusmiyati, K. (2021). Analysis of e-learning problems during covid-19 pandemic. *Jurnal Pijar Mipa*, *16*(5), 631-635.

[9] Wulansari, E. W., Kantun, S., & Suharso, P. (2018). Pengembangan e-modul pembelajaran ekonomi materi pasar modal untuk siswa kelas XI IPS MAN 1 Jember tahun ajaran 2016/2017. *JURNAL PENDIDIKAN EKONOMI: Jurnal Ilmiah Ilmu Pendidikan, Ilmu Ekonomi Dan Ilmu Sosial*, *12*(1), 1-7.

[10] Puspitasari, A. D. (2019). Penerapan media pembelajaran fisika menggunakan modul cetak dan modul elektronik pada siswa SMA. *JPF (Jurnal Pendidikan Fisika) Universitas Islam Negeri Alauddin Makassar*, *7*(1), 17-25.

[11] Nworgu, L. N., & Otum, V. V. (2013). Effect of guided inquiry with analogy instructional strategy on students acquisition of science process skills. *Journal Education and Practice 4,(27) 35*, *40*.

[12] Sari, M. M., & Muchlis, M. (2022). Improving critical thinking skills of high school students through guided inquiry implementation for learning reaction rate concept in chemistry. *Jurnal Pijar Mipa*, *17*(2), 169-174.

[13] Nurfidayanti, H. N., & Yonata, B. (2022). Development of student worksheets based on guided inquiries to train students science process skills on reaction rate materials. *Jurnal Pijar Mipa*, *17*(1), 8-15.

[14] Sinaga, K. (2017). Penerapan flipped classroom pada mata kuliah kimia dasar untuk meningkatkan self-regulated learning belajar mahasiswa. *Jurnal Inovasi Pendidikan Kimia*, *11*(2).

[15] Subagia, I. M. (2017). Penerapan model pembelajaran flipped classroom untuk meningkatkan prestasi belajar ipa siswa kelas x ap 5 smk negeri 1 amalapura i. Pendahuluan tahun ajaran 2016/2017. *Lampuhyang*, *8*(2), 14-25.

[16] Hidayat, M. I. M., & Subekti, H. (2022). Promoting science process skills and learning outcomes through cybergogy approaches with PhET media for Junior High School Students. *Jurnal Pijar Mipa*, *17*(4), 499-506.

[17] Is' ad, N., & Sukarmin, S. (2022). Implementation of problem-solving learning model assisted by student worksheets to improve critical thinking skills in the context of reaction rate. *Jurnal Pijar Mipa*, *17*(2), 199-208.

[18] Wang, J., Jou, M., Lv, Y., & Huang, C. C. (2018). An investigation on teaching performances of model-based flipping classroom for physics supported by modern teaching technologies. *Computers in Human Behavior*, *84*, 36-48.

[19] Solikah, M., & Novita, D. (2022). The effectiveness of the guided inquiries learning model on the critical thinking ability of students. *Jurnal Pijar Mipa*, *17*(2), 184-191.

[20] Sari, I. K. W. (2020). Analisis kemampuan kognitif dalam pembelajaran IPA SMP. *Jurnal Pendidikan dan Pembelajaran Sains Indonesia (JPPSI)*, *3*(2), 145-152.

[21] Arantika, J., Saputro, S., & Mulyani, S. (2019, February). Effectiveness of guided inquiry-based module to improve science process skills. In *Journal of physics: conference series* (Vol. 1157, No. 4, p. 042019). IOP Publishing.

[22] Hikmah, B. F. R., Artayasa, I. P., & Rasmi, D. A. C. (2021). Pengembangan LKPD berbasis keterampilan proses sains dalam model pembelajaran inkuiri terbimbing materi struktur dan fungsi jaringan tumbuhan di SMP. *Jurnal Pijar Mipa*, *16*(3), 345-352.

[23] Hovlid, E., Bukve, O., Haug, K., Aslaksen, A. B., & von Plessen, C. (2012). Sustainability of healthcare improvement: what can we learn from learning theory?. *BMC health services research*, *12*(1), 1-13.

[24] Serevina, V., Astra, I., & Sari, I. J. (2018). Development of E-Module Based on Problem Based Learning (PBL) on Heat and Temperature to Improve Student's Science Process Skill. *Turkish Online Journal of Educational Technology-TOJET*, *17*(3), 26-36.