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Development of flipped classroom learning assisted by interactive media on geometry materials for class V elementary school

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ABSTRACT

Complaints expressed by teachers currently are that the material is dense and the time given is limited. The teacher's limited time in explaining the material certainly requires students to be able to study independently at home to understand and deepen the material being studied. Teachers cannot control students' understanding of learning material provided through media at home. The aim of this research is to produce effective flipped class learning assisted by interactive media in fifth-grade elementary school class material. This research answers the weakness of flipped classroom learning, namely that teachers cannot control student learning of the material provided through learning media. This type of research involves research and development using 4D models. In this article, what is discussed is the effectiveness of flipped classroom learning assisted by interactive media. Based on the results of the research conducted, it can be concluded that the effectiveness of flipped classroom learning assisted by interactive media is 86.50% in the very effective category. Meanwhile, effectiveness was tested using pre-test and post-test results of 0.73 with a high N-Gain test with effective criteria. From the results of this research, it can be recommended that teachers use flipped classroom learning assisted by interactive media because it has been proven to be effective. Future researchers are advised to conduct research on flipped classes with the help of interactive media and other materials.

1. Introduction

Results of the Research on Improvement of System Education (RISE) study in Indonesia in 2018 [1] show that the ability of students to solve simple math problems is not significantly different between students who have just entered the basic education level (SD) and students who have completed senior secondary education (SMA). The Director General of Elementary and Secondary Education of the Ministry of Education and Culture, Hamid Muhammad, said that the low mathematics ability of students in Indonesia is not new and can be corrected by increasing the competence of educators through guidance on Techniques to Strengthen the Learning Process. Educators are expected to be able to focus on the material and "skills" of using mathematics in everyday life, with an increase in their competence in learning mathematics. Kaiser explained that thinking mathematically means (1) developing a mathematical perspective, evaluating the processes of mathematization and abstraction, and enjoying its practical application, and (2) acquiring competence and utilizing it to comprehend mathematics. The implication is that teachers should design learning experiences effectively, considering specific characteristics, so they can assist students in constructing meaningful understanding [2]. Teachers who are in direct contact with students and parents have self-confidence and perceived self-efficacy toward technology integration, and if teachers use various methods, techniques, applications, and technology effectively, this can change

the perspective of stakeholders and bring success [3]. Technological developments should assist teachers in responding to challenges in learning, especially in mathematics. The complaints submitted by teachers at this time are the density of material and the limited time provided. Therefore, teachers must be able to use technology to solve these problems. The teacher's limited time to explain the material certainly requires students to be able to study independently at home to understand and explore the material being studied. Based on the research results of Mulyaning Tyas in [4], the results obtained showed that the teacher's limitations in explaining the material resulted in low student learning outcomes. In addition, students also experience difficulties understanding the content and the learning process [5].

Supposedly, in classroom learning, students and teachers should interact more. The teacher does not only explain learning material; the teacher should spend more time debriefing and discussing material that has not been understood. This means that students should have studied the material that will be studied that day beforehand at home so that they are ready and have initial knowledge about the material to be studied. Students also already have questions that will be asked about which part of the material they have not understood. According to opinion [6], learning mathematics must be mastered holistically and comprehensively, which optimizes the existence and role of students in learning. One learning model that can be used for this problem is the flipped classroom model. The flipped classroom model [7] is the traditional reverse learning model (activities that should be done at school are done at home, and activities that are usually done at home are done at school). Teachers are asked to prepare learning videos that students can study independently at home before they come to school. At school, the teacher revisits the material that students do not understand and explains it once more. Additionally, students are assigned exercises to be completed during class [8].

In flipped classroom learning, students can control their own learning process without space and time limitations according to their individual differences, needs, and speeds while they are active and play a more interactive role with others in class activities [9]. Many studies on the flipped classroom model state that it influences student learning outcomes. Based on the results of Samarraie's research, which reviewed the use of flipped classrooms in seven disciplines, the potential for improving specific learning outcomes (e.g., engagement, attitudes, metacognition, performance, self-efficacy, and understanding) across disciplines through the flipped classroom model is demonstrated. This model is related to developing students' deep understanding of the material by granting them greater control over what and how they learn. Additionally, the flipped classroom has been found to assist students in transferring their knowledge between contexts, thereby strengthening their conceptual understanding [10]. The results of other studies also state that the flipped classroom model significantly influences learning outcomes [11]–[13]. Based on research results [14], It was found that students' conceptual understanding using the flipped classroom model was higher than students understanding using conventional learning.

According to some of these studies, the flipped classroom model has its drawbacks, namely that students who are less independent find it difficult to find and understand learning material. In addition, from the results of research [15]. There is a suggestion that teachers should add monitoring tools that can ensure students watch learning videos, such as, for example, after students make material notes from learning videos, they immediately send them via email to the teacher. One of the ways teachers use technology is by using learning media that students can access anytime and anywhere. According to several recommendations from previous research, teachers are advised to create interactive media that can monitor students while they watch learning videos and study at home. Therefore, in this study, the teacher used interactive media that could answer the recommendations from the previous research. Interactive media is the integration of digital media, including a combination of electronic text, graphics, moving images, and sound, into a structured digital computerized environment that enables people to interact with data for appropriate purposes [16]. Interactive, in this case, means the potential of technical tools to maintain human-digital relations with aspects that require participation and interaction [17]. This study used interactive media in the form of a web, namely a live worksheet. Live worksheets.

The Live Worksheets application is an application that can be accessed on Google and is a free application. This application can help teachers turn printed or paper worksheets into interactive online exercises, and the live worksheets application can also correct them automatically. Students can work on and send their worksheets to teachers online [18], and teachers can directly monitor students' understanding of the material provided at home before going to school. The advantage of the live worksheet application for students is that it can motivate learning because there are various funny

features in it, so children are enthusiastic about doing it, while for teachers, the live worksheet application can save time and paper. Therefore, flipped classroom learning is assisted by using interactive media so that students can be well-controlled when studying at home.

2. Method

This research involves research and development using the 4-D model. Based on [19], [20], Development research is conducted to develop a product or to perfect a particular product. In this development research, it only reached 3-D, namely the define, design, and develop stages. At the definition stage, needs analysis, student analysis, curriculum analysis, and student characteristics analysis are carried out. The design phase is carried out by making a flipped classroom learning design and using interactive media. The next stage is the development stage. In the development stage, validation, practicality, and effectiveness of flipped classroom learning with the help of interactive media are carried out in class V elementary school classroom materials. In the flipped classroom learning development research assisted by interactive media, one teacher and 28 students were the respondents. Research instruments in the form of validation sheets, practicality questionnaires, and tests were used to collect data relating to the validity, practicality, and effectiveness of the products being developed. The validity/practicality value is obtained by the following formula, and then the validity and practicality are categorized based on Table 1 and Table 2 [21].

$$\text{Value Validity/Practicality} = \frac{Total\ Score\ Obtained}{Maximum\ Total\ Score} x\ 100\% \quad (1)$$

Table 1. Validity Category

Achievement Level (%)	Category
90 – 100	Very Valid
80 - 89	Valid
65 - 79	Fair
55 – 64	Less Valid
0 – 54	Not Valid

The effectiveness of the use of learning models [22] can be seen from several things, including: (1) the results of student responses to the learning model applied; and (2) the results of calculating the N-Gain value. The data analysis technique used in the questionnaire results is descriptive analysis. This analysis is used to determine the effectiveness of the learning model based on its level of implementation and usefulness.

Table 2. Practicality Category

Achievement Level (%)	Category
90 – 100	Very Practical
80 - 89	Practical
65 - 79	Fair
55 – 64	Less Practical
0 – 54	Not Practical

The results of this analysis are in the form of the overall percentage of each student's response related to the treatment of the independent variables. The formula for calculating the percentage score can be seen in Formula 3. From this percentage, the level of effectiveness can then be categorized based on the level. Criteria for the level of effectiveness can be seen in Table 3.

$$P = \frac{\sum all\ of\ questionaire\ answer}{(number\ of\ questionaire\ items\ x\ highest\ score\ x\ number\ of\ respondents} \quad (2)$$

Table 3. Effectiveness Criteria [23]

Achievement Level (%)	Category
0 – 20	Very ineffective
21 - 40	Ineffective
41 - 60	Less effective
61 – 80	Effective
81 - 100	Very Effective

The level of effectiveness can then be calculated from the N-Gain value. The formula for calculating the N-Gain value can be seen in Formula 2. The criteria for the N-Gain value can be seen in Table 4. Meanwhile, the effectiveness interpretation category based on the N-Gain value can be seen in Table 5.

$$Gain\ Score\ = \frac{(\%\ posttest\ mean\ score - \%\ pretest\ mean\ score}{(100\% - \%\ pretest\ mean\ score)} \quad (3)$$

Table 4. N-Gain Score Criteria [24]

Gain Score Results	Criteria
Gain > 0.7	High
0.7 ≥ gain ≥ 0.3	Medium
Gain < 0.3	Low

Table 5. Gain Effectiveness Interpretation Category [25]

Persentase (%)	Interpretation
< 40	Ineffective
40 – 55	Less effective
56 - 75	Effective
< 76	Very Effective

3. Results and Discussion

This research is a continuation of previous research. In the previous article, we discussed the validity and practicality of flipped classroom learning with the help of interactive media. For this reason, this article discusses the effectiveness of flipped classroom learning with the help of interactive media in class V elementary school buildings. As mentioned in the previous article, the validity of flipped classroom learning assisted by interactive media in the form of lesson plans is as Table 6.

Table 6. RPP Validation Results

Assessment Aspects	Score	Max Score	Persentase (%)	Criteria
Format	23	25	92	Very Valid
Learning Activities	40	50	80	Valid
Language	7	10	70	Fair
Rata-rata			80,66667	Valid

From Table 6 can be concluded that the value for the Language indicator is in the fair category. This is because the RPP contains slightly convoluted language. In learning activities, valid results were obtained because there were several activities that required time control in their implementation. However, the format is very valid because it complies with school regulations. The validity of the interactive media can be seen as Table 7.

Table 7. Analysis of data on the practicality of Flipped Classroom learning with the help of interactive media on materials for class V elementary school teachers

Assessment Aspects	Score obtained	Max Score	Persentase (%)	Criteria
Applicability	8	8	100%	Very Practical
Execution	30	32	93,75%	Very Practical
Total	46	52	-	-
Average	-	-	96,875%	Very Practical

From the results of the practicality analysis tested on teachers and students, see Table 8, it was concluded that flipped classroom learning assisted by interactive media was very practical. This is because students can study the material they will study at home before coming to school. Apart from that, students can also repeat material that they have not yet understood and there is also learning video assistance in understanding the lesson material. Various studies have proven that the flipped classroom learning model is proven to be more effective in improving the quality of learning and student activity in the learning process and providing better learning outcomes as well [26]. Based on the results of research conducted by Comber et al., it can be concluded that Flipped Classroom learning is an alternative that can make the relatively limited face-to-face learning time more effective and help enhance student learning outcomes [27].

This is also supported by research [28], the average learning outcomes of students who use videos Mathematics learning through the Flipped Classroom learning model is better than average learning outcomes of students who use conventional learning. The effectiveness test was also carried out in two ways, namely by giving responses to questionnaires and tests. Response questionnaires were given to students when the posttest was completed. The purpose of this response questionnaire was to find out student responses to flipped classroom learning assisted by interactive media that was applied during experimental activities. The resulting data is in the form of descriptive data regarding the implementation and usefulness of the learning.

Table 8. Data analysis of the practicality of learning Flipped Classroom with the help of interactive media on material for class V SD by students

Assessment Aspects	Score obtained	Max Score	Persentase (%)	Criteria
Learning process	123	140	87,85%	Very Practical
Material Presentation	130	140	92,85%	Very Practical
Instructional Media	129	140	92,14%	Very Practical
Practice on Media	124	140	90,74%	Very Practical
Language	128	140	91,42%	Very Practical
Physical form	126	140	90,00%	Very Practical
Benefit	130	140	92,85%	Very Practical
Total	890	980	-	-
Avarage	-	-	92,38%	Very Practical

The response of the majority of students to the application of flipped classroom learning assisted by interactive media is very effective. This shows that flipped classroom learning with the help of interactive media has been carried out properly according to its stages. In addition, flipped classroom learning is also considered to have very good benefits by students. Flipped classroom learning activities make students responsible for the material they learn, see Table 9. Students can study the material at home before coming to school.

Table 9. Summary of Questionnaire Descriptive Analysis of Student Responses to Flipped Classroom Learning

Implementation Aspect	Number of Respondents	Average Score Questionnaire	Persentase (%)	Effectiveness Criteria
Flipped classroom learning is assisted by interactive media.	28 students	3,49	86,50	Very effective

Teachers can also control students' understanding in the teacher's account so that teachers can evaluate and follow up at school before being given practice. Students' positive responses to flipped classroom learning assisted by interactive media also occurred in previous research. Research [29] shows that it is effective for increasing creative attitudes, responsibility, and learning skills. Accordingly, research [30] shows that the application of the Flipped Classroom-based learning model has a significant impact on aspects of student attitudes. Effectiveness is determined based on the calculation of the N-gain value from the average pretest and posttest scores of 28 students. The results of calculating the N-gain value can be seen in Table 10.

Table 10. N-Gain Calculation Results

Pretest average	Average Postes	Gain Score	Persentase
63,33	89,62	0,73	73%

Table 10 shows an N-Gain value of 0.73. Based on the N-Gain Score criteria table, the N-Gain value obtained is included in the high criteria. Meanwhile, if seen in Table 3, the category of interpretation of gain effectiveness is based on percentage, then the N-Gain gain of 73% is included in the category of effective interpretation. The results showed that there was an increase in the average pretest and posttest scores. This is the same as previous research. Research [31] concluded that the application of the flipped classroom learning model assisted by PowerPoint and audiovisual media could improve cognitive learning outcomes.

4. Conclusion

From the results of the practicality analysis tested on teachers and students, it was concluded that flipped classroom learning assisted by interactive media was very practical. This is because students can study the material they will study at home before coming to school. Apart from that, students can also repeat material that they have not yet understood and there is also learning video assistance in understanding the lesson material. Various studies have proven that the flipped classroom learning model is proven to be more effective in improving the quality of learning and student activity in the learning process and providing better learning outcomes as well. From the results of the research conducted, it can be concluded that the effectiveness of flipped classroom learning assisted by interactive media is 86.50% in the very effective category. Meanwhile, effectiveness was tested using pre-test and post-test results of 0.73 with a high N-Gain test with effective criteria. Flipped Classroom learning assisted by interactive media can be used as an alternative that can make the relatively small amount of face-to-face learning time more effective and help improve student learning outcomes. From the results of this research, it can be recommended that teachers use flipped classroom learning assisted by interactive media because it is proven effective. Future researchers are advised to conduct research on flipped classes with the help of interactive media and other materials.

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