

# Learning media projects with YouTube videos: a dynamic tool for improving mathematics achievement

Imam Kusmaryono, Mochamad Abdul Basir

Department of Mathematics Education, Faculty of Teacher Training and Education, Universitas Islam Sultan Agung, Semarang, Indonesia

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## ABSTRACT

This research was designed with a descriptive research approach. The research objectives of the study were to: i) investigate the impact of the project task of learning video media on prospective teachers and students; ii) analyze the important role of instructional video media as a learning assistant for students; and iii) describe the function of instructional video media in increasing students' interest and achievement in learning. This research involved 100 participants consisting of 10 students of a teacher education study program (prospective teachers), and 90 junior high school students. The researchers collected data through tests; questionnaires; and interviews. Researchers analyzed the data through descriptive statistical analysis. The results of the study indicated that the project assignment of making videos for learning (on a YouTube channel) provided a positive impact on learning experiences for teachers (prospective teachers) and students. Mathematics learning video media has a role as a digital native that may help overcome the limitations of students' knowledge and understanding. Mathematics learning videos on the YouTube channel can be a dynamic tool to increase students' interest (as an attention, and affective function) and to improve students' mathematics learning achievement (as a cognitive function).

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### Corresponding Author:

Imam Kusmaryono

Department of Mathematics Education, Faculty of Teacher Training and Education,

Universitas Islam Sultan Agung

Jalan Raya Kaligawe KM. 4, Kecamatan Genuk, Kota Semarang, Indonesia

Email: kusmaryono@unissula.ac.id

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## 1. INTRODUCTION

In today's modern era, society is faced with the rapid development of information technology. Information technology is defined as a tool to support a job or task related to information processing. It is undeniable that (digital) information technology has contributed to education, including in mathematics learning as an appropriate technological resource in a multidimensional concept [1], [2]. Advances in technology have had an impact on the existence of mathematics subjects in schools. The role of educators (mathematics teachers) is enormously significant in responding to global challenges through creativity in learning mathematics. Mathematics teachers are required to prepare themselves to face changes such as changes in curriculum, learning media, infrastructure, and implementation. A new paradigm of mathematics learning has brought an impact on emphasizing changes in the learning process. This change has shifted the focus of all paradigms in education around the world. Face-to-face learning (offline learning) turns into online learning by utilizing digital technology [3].

In order to respond to technological developments, teachers and students require to have digital literacy skills. United Nations Educational, Scientific and Cultural Organization (UNESCO) described that digital literacy is a skill that does not only involve the ability to use technology, information, and communication devices, but also involves the ability to learn to socialize, think critically, and creatively, and inspire in digital competition [4], [5]. The higher the level of literacy, the higher the reading interest in absorbing knowledge which has an impact on improving the quality of superior human resources [6].

Technological advances have an impact on the existence of learning management in schools. The role of educators (teachers) is immense in responding to global challenges through creativity in learning. Teachers are required to prepare themselves for changes such as curriculum changes, learning processes, learning media, infrastructure, and implementation. There are many platforms and various digital learning technologies that can accommodate teachers and students to their learning demand. Teachers obtain many advantages from the available digital technology-based learning resources or their own-developed media [7]. Teachers and students using YouTube video application is a representation of technology usage in mathematics education and learning [3]. However, teachers require to comprehend several aspects of presenting videos as learning media, namely appropriate material for presentation, appropriate delivery techniques, optimal quality video production, and skills in making videos according to the latest developments [2], [3].

Technical and non-technical problems occur in distance learning (online). In mathematics learning, students often do not understand the teacher's explanation. Students should repeat learning at home independently. However, during independent learning, students have obstacles in understanding and remembering mathematics subject material. The limitation of learning media is one of factors causing the students' low interest and achievement in learning mathematics [8]. Therefore, learning technology is required for students to ease them repeating and learning mathematics material more carefully. This is where the technology takes role to answer the problems faced in the world of education [2].

Interest in learning is an individual's tendency to have more interest, attention, pleasure, and desire to have learning and study. The interest in learning could generate changes in knowledge, skills, and behavior [9]–[11]. Indicators of interest in learning are feeling happy, interested in learning, showing attention while studying, and involvement in learning [11], [12]. The interest will settle and develop to gain support from his environment in the form of experiences. Interest in learning mathematics is a tendency to prefer and feel so convenient in learning mathematics that students are interested to participate in the mathematics learning process. Factors that cause interest in learning are encouragement from within the individual, namely social motive encouragement and emotional encouragement. Students who have a great interest in a particular field of study will focus more attention than other students [13], [14]. If students have an interest in the lesson, then they will study seriously and learning achievement will increase [12]. Students with high interest can easily get through the competition and challenges they face [13].

Based on literature search (tracking) research that has been conducted by previous experts, it was found that low learning achievement was affected by low interest in learning (internal factors) [10], [14], and the use of less attractive media or teaching assistant (external factors) [10], [11]. The results of a previous survey conducted by researchers on 100 junior high school mathematics teachers suggested that 45% of respondents used PowerPoint media for learning mathematics, 22% of respondents used learning videos from YouTube, and 33% of respondents only used textbooks for learning mathematics. The results of this survey indicated that teachers had not been able to develop mathematics learning media according to the latest technological developments in the new era. Therefore, teachers and prospective teachers need to be equipped with skills to develop instructional video media. Teachers in today's era must be more prepared, creative, and innovative in utilizing the latest technology to increase student interest and learning achievement [15].

This research is motivated by the problem of mathematics teachers' low creativity in developing learning media [16], and students' low interest and achievement in mathematics learning [17]. The mathematics teachers used digital media in learning less optimally. Therefore, it is necessary to conduct a study on learning video creation projects using YouTube technology and their impact on increasing student interest and achievement. Besides, the use of learning technology must also be followed by the transformation of learning patterns by teachers and students. New-era teachers must be more prepared, creative, and innovative in carrying out learning by utilizing the latest technology [15]. On the other hand, teachers (prospective teachers) must be equipped with skills in using learning technology so that they are capable to increase student interest and achievement.

The purposes of this study were to: i) investigate the impact of the project task of creating mathematics learning video media for teachers (prospective teachers) and students; ii) analyze the important role of instructional video media as an assistant for helping student in learning; and iii) describe the function of instructional video media in increasing students' interest and achievement in learning mathematics. The results of this study are expected to contribute to the existence of new literature that is useful for teachers and prospective teachers regarding: i) the importance of using digital technology for the benefit of self-

development and learning innovation; ii) construct meaning in the context of learning mathematics which is easier for students to understand; and iii) increasing students' interest in learning, active participation of students, and student's ability to learn independently as well as increasing attention, affective, and cognitive functions for students. Based on the background and problems that have been described, a research hypothesis is proposed. The hypothesis of this research: i) there is a positive influence from the project task of making learning video media obtained by teachers (prospective teachers); ii) learning videos have an important meaning in supporting the understanding of mathematics subject matter; and iii) learning videos can play a role in increasing students' learning interest (as a function of attention and affective) and increasing student achievement (as a cognitive function).

## **2. RESEARCH METHOD**

### **2.1. Research design**

This research was designed with a descriptive approach. Descriptive research creates a systematic, actual, and accurate description of the facts, characteristics, and correlations between the phenomena investigated. The focus of this study was to describe the impact of the project task of making learning videos by teacher education students (teacher candidates) and students' responses and implementation of learning videos in mathematics learning in junior high schools. The development of learning videos followed the analysis, design, development, implementation, and evaluation (ADDIE) model [18].

In this study, the videos used in learning mathematics were videos created by students of teacher education study program (as teachers). Material and video models are played by teachers (prospective teachers) in mathematics. The teacher who acts as a video model means that students will experience direct learning with the teacher as if they were face-to-face in class. This learning video is uploaded on the YouTube channel so students could re-watch the videos for independent learning any time. The advantages of learning videos created by teachers, include: i) being able to clarify abstract matters and provide more realistic explanations; ii) being able to become the main medium for documenting social reality which will be discussed in class; and iii) being able to act as a storyteller who can provoke students' creativity in expressing their ideas.

### **2.2. Respondents**

This research involved 100 participants consisting of 10 students of teacher education study program (prospective teachers), and 90 junior high school students. The researcher is a lecturer in mathematics education at Universitas Islam Sultan Agung, Semarang, Indonesia. The students of teacher education study program (prospective teachers) are students who were taking realistic mathematics education course. Their task is to create a mathematics learning video project and apply the video in teaching mathematics practice at school. The video content contained realistic mathematics problem-solving in daily life. Junior high school students participate as users of learning videos and respond to learning videos that are used as learning resources.

### **2.3. Data collection techniques and instruments**

The researchers collected data through the test, questionnaire, and interviews. Test instrument was used to obtain data on student achievement. The questionnaire instrument consisted of: i) a student response questionnaire to the learning videos based on Rogers' theory [19]. This instrument was developed through five indicator factors, namely relative advantage, suitability, complexity, trial and error [17], [19]; and ii) a questionnaire of students' interest in learning which contains closed and open-ended questions to obtain deeper information about students' learning interests. The interview instrument contained a list of questions arranged in a semi-structured manner. Researchers conducted direct interviews with mathematics teachers to obtain information about the impact of using instructional media on self-competence and learning.

### **2.4. Data analysis**

The researchers conducted data analysis using descriptive statistical analysis and rating tables with a Likert scale [20], [21]. The results of student responses to the use of learning videos will be strengthened through open-ended questions. The data in this qualitative research was validated through test of credibility, transferability, dependability, and confirmability [22]. Next, the researchers conducted a meta-analysis to summarize the findings and review the appropriate theories so as to contribute to the research conclusions.

### 3. RESULTS AND DISCUSSION

#### 3.1. Results

##### 3.1.1. Assessment of video project assignments and student's responses

Learning video media as a result of project assignments (10 videos) have been uploaded on the YouTube channel. However, after conducting evaluation on those videos, only 5 videos were selected as the material was appropriate for junior high school students. All learning video products have met the "good" criteria. Table 1 shows the result of the learning video assessment.

Table 1. Learning video assessment criteria

Assessment Criteria	Score rating video (V)				
	V1	V2	V3	V4	V5
Suitability with the theme	3.60	3.50	3.40	3.60	3.50
Ideas and messages conveyed	3.75	3.50	3.70	3.60	3.60
Audio-visual quality	3.50	3.60	3.65	3.50	3.70
Uniqueness and creativity	3.30	3.70	3.50	3.50	3.60
Average score	3.52	3.58	3.55	3.55	3.60
Criteria	Good	Good	Good	Good	Good

The videos have been used in mathematics learning in junior high school. Students (respondents) were asked to fill in a number of responses to this learning video. The result of student responses to the learning refer to responses according to each indicator as presented in Table 2.

Table 2. Scores obtained from questionnaire of student responses to the learning videos

Factors-indicators	Score mean	Standard deviation	Criteria response
Relative advantage	3.76	.124	Good
suitability	3.81	.093	Good
Complexity	3.70	.058	Good
Trialability	3.79	.071	Good
Observability	3.75	.060	Good
Average	3.76	.081	Good

The average score of each questionnaire indicator is close to 4.0 with a very small standard deviation. In general, implementation of videos in mathematics learning for junior high school students received a good (positive) response. There were five learning videos (V1, V2, V3, V4, and V5) implemented as mathematics learning media in junior high schools. After students involved in mathematics learning assisted by videos from the YouTube channel, students filled out the learning interest questionnaires.

##### 3.1.2. Result of interest and learning achievement questionnaire

After all respondents (students) filled out the questionnaire, the researcher analyzed the questionnaire based on descriptive statistics. The questionnaire contained questions according to the indicators of interest in learning. The achievement of each indicator is presented in Table 3.

Table 3. Student learning interest scores

Learning interest indicator	Questionnaire score of interest in learning mathematics			Average score
	Class-A (N=30)	Class-B (N=28)	Class-C (N=32)	
Feeling happy	4.00	3.82	3.73	3.85
Interested to learn	3.92	4.00	3.85	3.92
Showing attention while studying	3.54	3.78	3.61	3.64
Engagement in learning	3.75	3.64	3.69	3.69
Total score	456	427	476	1359
Learning interest criteria	High	High	High	High

In this study, each sample group received two learning treatments, namely learning without the help of learning videos and learning with the help of learning videos. At the end of learning, students completed the learning achievement test. Data of student achievement assisted by learning videos compared to student achievement without the aid of learning videos is presented in Table 4.

Table 4. Student learning achievement scores

Student group	Number of students	Learning without YouTube video media		Learning with YouTube video media	
		Mean	Standard deviation	Mean	Standard deviation
Class-A	30	75.14	12.610	86.70	8.174
Class-B	28	73.98	9.375	81.90	7.093
Class-C	32	70.20	10.654	79.50	9.584
Total	90	-	-	-	-
Average	-	73.02	11.978	82.70	10.260

At the end of the study, students (respondents) were given open-ended questions. Student answers are grouped by percentage. Questions containing students' responses and interests in the mathematics learning video are summarized in Table 5.

Teachers (student teacher candidates) who teach mathematics were also interviewed by the researchers. The interview questions were semi-structured where the questions could be developed by the researcher. The results of interviews with teachers are summarized in Table 6.

Table 5. Excerpt of respondents' answers to open-ended questions

Code	Questions and answers	Percentage (%)
<b>Q-1</b>	<b><i>Why did you choose learning videos (on the YouTube channel) as a tool for learning mathematics?</i></b>	
A-01	I can watch video content repeatedly and my knowledge is deeper about mathematics material.	52
A-02	I am happy and I don't feel bored because this video presents learning mathematics in a clear and interesting way.	30
A-03	Whenever and wherever I can access videos quickly and easily for me to learn mathematics.	18
<b>Q-2</b>	<b><i>Can learning videos (on the YouTube channel) improve your learning achievement?</i></b>	
A-01	Learning videos can certainly increase my interest and motivation in learning, and avoid math anxiety.	50
A-02	This learning video improves math achievement because previously I was lazy to learn math.	30
A-03	I can understand math material faster than learning it through textbooks.	20
<b>Q-3</b>	<b><i>How do you feel after learning with the help of learning videos (on the YouTube channel)?</i></b>	
A-01	I feel happy and interested in studying the visual images or symbols of this video. Students used to find math boring, but now I love math.	61
A-02	At first, I wasn't interested in this video, but it turns out that math is easy to understand and not difficult.	29
A-03	I wish there were more teacher-prepared math learning videos.	10
<b>Q-4</b>	<b><i>How do you do if there is material in the learning video (on the YouTube channel) that you don't understand?</i></b>	
A-01	When going to ask the teacher or discuss with other friends.	45
A-02	I will definitely be challenged to study the material in this learning video over and over again until I understand it.	30
A-03	I will look for other learning resources or videos to help me study.	25
<b>Q-5</b>	<b><i>What is the positive impact of the development of this digital technology?</i></b>	
A-01	I can study more flexibly and easily get information on learning resources online.	55
A-02	I can understand math concepts better and deeper through YouTube videos.	25
A-03	I have an increased interest and enthusiasm for learning, especially to discover more knowledge.	20

Table 6. Excerpt of interviews with mathematics teachers

Code	Questions and answers
<b>Q-1</b>	<b><i>What experience did you get while carrying out the YouTube video project assignment as a medium for learning mathematics?</i></b>
T-01	I got creative practical experience in making learning videos and teaching students appropriately.
T-02	I feel challenged to find new and creative ways to develop interesting learning media
<b>Q-2</b>	<b><i>Are you sure your math learning videos will appeal to students?</i></b>
T-01	I wasn't sure at first, but I'm trying to make better learning videos.
T-02	I am sure that students will like this video because it contains solving everyday problems, and I am challenged to make more interesting videos.
<b>Q-3</b>	<b><i>What is your role if students have learning difficulties through YouTube videos?</i></b>
T-01	I will provide assistance to students with lessons they do not understand.
T-02	I always accompany students when they were learning through learning videos and I am always ready to serve students who have learning difficulties.
<b>Q-4</b>	<b><i>What is the positive impact of you the development of this digital technology?</i></b>
T-01	I find it easy to involve in learning; I have the skills to create interesting learning video media; and I am motivated to always improve the quality of learning (in mathematics learning).
T-02	I have to equip myself with interactive learning management skills; I am driven to improve my competence and quality according to the latest developments in educational technology; and I should adapt to the times because the learning process can be accommodated by technology.

## 3.2. Discussion

### 3.2.1. The important role of learning videos in the digital learning era

Based on the data in Table 1, the researchers could report that the mathematics learning video project assignments have been completed successfully. Learning videos made by teachers (prospective teachers) had good contents and messages according to the learning objectives. Thus, it can be said that the learning videos made are included in a valid category and can be applied to mathematics learning. According to learning technology experts, the more complex the demands of learning outcomes that must be met, the more learning media have an important role in achieving learning objectives [14], [23]. Learning videos are media that can accommodate learning material in a more attractive presentation. In addition, learning videos may display learning messages in so realistic way that students could easily understand the materials in learning (Table 5; Q-3). This also affected on how students were able to achieve learning goals and comprehension of mathematical concepts [24]. Good quality learning videos had met the criteria for easy and understandable lesson content for students, encouraged their interest and curiosity to learn, and could be assistance while studying at home[25].

Mathematics learning assisted by YouTube video media has changed the learning paradigm from mechanical concepts (memorization) to digital learning methods. The presence of learning videos through the YouTube channel is a creative innovation from teachers in the digital learning era [17], [26]. Learning videos created and modeled by teachers are innovative and effective as an alternative pedagogical method [17]. Mathematics learning videos on the YouTube channel has emerged as digital natives to overcome the limitations of students' knowledge and understanding. Difficult and complicated mathematical concepts and topics can be presented in more realistically, contextually, and easier way [17], [27]. Students might be studied by using the learning video repeatedly to gain better concept comprehension.

The project task of creating learning videos (on the YouTube channel) has had a major impact on the learning experience for teachers (prospective teachers) (Table 6; Q-1). They got practical and innovative experiences in producing learning videos and teaching students properly [25]. They also feel challenged to find new and creative ways to develop interesting learning media [17]. The teachers (prospective teachers) seemed to understand several aspects in presenting videos as learning media, including the appropriate material for presentation, appropriate delivery techniques, optimal quality video production, and skills in creating videos according to the latest development [28].

Explicitly the development of digital technology, especially in learning, has had a positive impact on teachers and students. Result of analysis on interview data (Table 6; Q-4) indicated that the teachers conveyed the impact of the digital technology development in education, including: i) teachers get convenience in conducting hybrid learning (offline and online); ii) teachers have the skills to create interesting learning video media [17]; iii) teachers are capable of improving the quality of learning (in mathematics learning); iv) teachers are required to equip themselves with interactive learning management skills; and v) teachers are required to improve their competence and self-quality according to the latest developments in educational technology [28]. On the other hand, the positive impacts obtained by students (Table 5; Q-5) are: i) students can learn more flexibly and easily get information on learning resources online [14]; ii) students can understand math concepts better and deeper through YouTube videos [29]; and iii) students' interest and enthusiasm for learning increased, especially to discover more knowledge.

### 3.2.2. Learning videos increase learning interest and achievement

Using videos as media for a learning is not only an effort to help teachers, but also to facilitate students in the learning process. Learning videos on the YouTube channel have received positive responses from students as their interest in learning increased [9], [29], [30] and the quality of learning improved [13], [31]. The students became more focused and motivated to participate in learning activities when the teacher conducted a learning by using videos on YouTube [32].

Result of interviews with students (Table 5: Q-3 and Q-4) indicated that the mathematics learning videos encouraged positive emotions for students while studying as they felt happy and challenged to discover more deeply [33]. Learning videos could revive students' interest and motivation which in turn can be conducive to the development of student achievement [34]. In Table 3, the results of the student learning interest questionnaire indicated a high learning interest score. Thus, it can be said that learning videos can increase student motivation and interest in learning as the videos they provide a variety of so attractive views that students would not feel bored while studying [29]. Considering Table 4, there was a difference in average points of students' mathematics achievement before (without YouTube videos) and after using YouTube videos as 9.96 points. Student achievement in each group also increased in all classes. Thus, it can be said that the use of learning videos is able to improve student achievement in mathematics [3], [30].

Summarizing the previous explanation, it is clear that learning videos as audio-visual-based media takes an important role in the learning process. Learning videos can facilitate understanding and strengthen students' memory while studying. Learning videos could encourage student interest and provide a correlation

between the material content and the real world. In other words, the implementation of videos in mathematics learning significantly increase student interest and learning achievement [17], [25], [35], [36].

### 3.2.3. Learning videos improve attention, affective, and cognitive functions

Result of the interviews (Table 5; Q-3) suggested that, at the beginning of the lesson, the students were not interested in the mathematics subject and had lack of attention onto the learning. However, the teacher attempted to direct students' attention to the mathematics learning videos (Table 6; Q-2). Afterward the students became interested and paid close attention to the videos (Table 5; Q-3). This condition was a clear evidence that the mathematics learning video has an attention function [37], [38], as the lesson content could attract students' attention and concentration in mathematics. The use of instructional video media had encouraged students' interest in learning. The learning material presented in the video was understandable for students. Interesting learning video media could be a stimulus for students as a challenge to learn mathematics [17], [39].

The affective function of learning video media could be seen in the level of student enjoyment while learning mathematics with graphical and audio-visual text [37]. According to the students (Table 5; Q-3), visual images or symbols can arouse the emotions and attitudes of students who previously thought mathematics was boring and difficult to enjoy while learning. Meanwhile, other students (Table 5; Q-3) revealed the cognitive function of the learning video media that visual symbols or images in the video provided convenience for students to understand mathematics material and to keep in mind the information or lesson content contained in the video [38]. Thus, it can be concluded that mathematics learning videos could be a dynamic tool to increase interest (as an attention and affective function) and improve students' mathematics learning achievement (as a cognitive function).

Result of the interviews implied that teachers (or prospective teachers) had practical experience in the classroom to practice creative teaching (Table 6; Q-1). The teachers were challenged to discover new and creative ways to develop interesting learning media [35]. In this case, the role of the teacher might change in a more positive direction. The teacher's burden for repeated explanations regarding the content of the lesson might be reduced or even eliminated.

On the other hand, the teacher could focus on other important aspects of mathematics teaching and learning process. Mastery of technology certainly accommodated the learning process and helped in improving the quality of education [40]. Therefore, digital transformation have a significant impact on the development of the educational community and the quality of education itself [41]–[43]. Based on the results of this study, there are several important implications in the management of learning mathematics, including: i) teachers (prospective teachers) require to be provided with practical experience in making technology-based learning media; ii) teachers must be creative in creating interesting and innovative mathematics learning content; and iii) tertiary institutions, especially through teacher education study programs, must encourage the development of technological pedagogical content knowledge (TPACK) competencies.

## 4. CONCLUSION

The project assignment of creating learning videos (on the YouTube channel) has had a major impact on providing learning experiences for teachers (prospective teachers). They gained practical and innovative experience in creating learning videos and teaching students appropriately. They felt challenged to discover new and creative ways to develop interesting and good-quality learning media. The implementation of learning video media (with a YouTube channel) has added a dimension to learning mathematics to be innovative, effective, interesting, and fun for students. Mathematics learning video media (with a YouTube channel) as a digital native could overcome the limitations of students' knowledge and understanding. Difficult and complicated mathematical concepts could be easily presented and understandable for students. The implementation of instructional video media (with the YouTube channel) as a learning medium has increased interest in learning and student achievement in mathematics. Videos on the YouTube channel could become a dynamic tool to increase students' interest (as an attention and affective function) and improve students' mathematics learning achievement (as a cognitive function). The results of this study have implications for the importance of teachers (prospective teachers) being provided with practical experience in making digital technology-based learning media. Further research is required to replicate this research by adding other influence variables. It is necessary to consider a larger sample size to determine whether learning videos really have a significant effect on mathematics achievement and can be generalized.

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## BIOGRAPHIES OF AUTHORS



**Imam Kusmaryono**    is associate professor and permanent lecturer in mathematics education at the Teaching and Education Faculty, Universitas Islam Sultan Agung, Semarang, Indonesia. He has the expertise in the fields of science: Statistics, research methodology, learning mathematics, and philosophy of mathematics education. Currently serves as secretary of the university's research institute. He can be contacted at: kusmaryono@unissula.ac.id.



**Mochamad Abdul Basir**    is a permanent lecturer in Mathematics Education at the Universitas Islam Sultan Agung, Semarang, Indonesia. Active as a researcher in the field of education at the elementary to university level. Has expertise in the fields of science: algebra, calculus, development of teaching materials, and philosophy of mathematics education. He can be contacted at email: abdulbasir@unissula.ac.id.