

IMPROVING STUDENTS' MOTIVATION AND LEARNING OUTCOMES ON TRIGONOMETRY THROUGH INTERACTIVE LEARNING MEDIA

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Abstract

Mathematics is a subject that is always taught at every level of education. However, many students still think mathematics is complex and boring. The problem that arises is that it is difficult for students to understand the concept of trigonometry, so 60% of student learning outcomes are still below the KKM. This is due to the lack of student motivation in learning mathematics. Teachers must create creative and fun learning innovations based on these problems using interactive learning media. This study aims to develop interactive learning media that are feasible, practical, and effective. The type of research carried out is research and development with a 4D model by Thiagarajan. It consists of define, design, develop, and disseminate. The research was conducted at MA Assa'adah Jamanis. Data collection techniques are observation, interviews, questionnaires, and tests. The data analysis technique used is the analysis of validity, practicality, and effectiveness. The results of the learning media research developed are very feasible based on the validators of material experts and media experts and practical according to student questionnaires. The value of t_{count} is greater than t_{table} ($20,494 > 2,131$). This shows a significant average difference between the pre-test and post-test, which means the interactive media developed effectively improves mathematics learning outcomes. Based on student questionnaires, aspects of providing assistance and learning motivation obtained 83% or excellent results.

Keywords: 4D model; articulate storyline; learning outcome; student motivation; trigonometry.

Abstrak

Matematika merupakan mata pelajaran yang selalu diajarkan pada setiap jenjang pendidikan. Namun, banyak siswa masih menganggap matematika adalah hal yang kompleks dan membosankan. Masalah yang muncul adalah siswa sulit memahami konsep trigonometri, sehingga hasil belajar siswa 60% masih di bawah KKM. Hal ini akibat kurangnya motivasi siswa dalam belajar matematika. Berdasarkan permasalahan tersebut, guru harus menciptakan inovasi pembelajaran yang kreatif dan menyenangkan dengan menggunakan media pembelajaran interaktif. Penelitian ini bertujuan untuk mengembangkan media pembelajaran interaktif yang memenuhi kriteria layak, praktis dan efektif. Jenis penelitian yang dilaksanakan adalah penelitian dan pengembangan dengan model 4D oleh Thiagarajan. Terdiri dari define, design, develop, dan disseminate. Penelitian dilakukan di MA Assa'adah Jamanis. Teknik pengumpulan data adalah observasi, wawancara, angket, dan tes. Teknik analisis data yang digunakan adalah analisis validitas dan kepraktisan serta keefektifan. Hasil penelitian media pembelajaran yang dikembangkan sangat layak berdasarkan validator ahli materi dan ahli media, serta praktis menurut angket siswa. Nilai t_{hitung} lebih besar dari t_{tabel} ($20,494 > 2,131$). Hal ini menunjukkan perbedaan rata-rata yang signifikan antara pre-test dan post-test, yang berarti media interaktif yang dikembangkan efektif dalam meningkatkan hasil belajar Matematika. Berdasarkan angket siswa, aspek pemberian bantuan dan motivasi belajar diperoleh hasil 83% atau sangat baik.

Kata kunci: Articulate storyline; hasil belajar; model 4D; motivasi siswa; trigonometri.



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INTRODUCTION

Mathematics has a crucial role in everyday life. However, for most Indonesian students, mathematics is very difficult subject. Although mathematics can be found at every level of education, many students still make mathematics a complicated and tedious issue (Permatasari et al., 2016). Trigonometry is considered a complex material by most students because trigonometry is abstract and has its level of difficulty (Nurcikawati et al., 2018).

Trigonometry is the compulsory mathematics studied in high school. Trigonometry is mainly contained in the content standards in the 2013 Curriculum. This material is also a prerequisite for studying limits, integrals, geometric transformations, and three dimensions and differentials (Sastrawati & Novallyan, 2017). However, trigonometry is a difficult topic because of its complex nature, which makes the students feel bored and ignore the lesson (Mahsunah & Waryanto, 2018). Therefore, in the learning process, the teacher should provide illustrations, learning resources, and learning media to stimulate students to be active, discovery-based, and contextual so that learning will be felt meaningful (Nurhayati et al., 2021).

Technology has a significant influence and contribution to education and even affects daily life nowadays. It is interesting to observe that children's interaction outside of school is in contact with technology, especially information technology. So in mastering technology, they tend to get quite comprehensive and complex information needed in their daily needs (Astuti et al., 2020). The application of information technology in teaching is more well-known than before. Several developments of digital technology in

the learning process have contributed significantly to improving the quality and effectiveness of education (Van Hong et al., 2018).

Based on preliminary observations in MA Assa'adah, the students still had difficulties with mathematics concepts or calculations, especially trigonometry. So, it is not to increase the abstraction power of students in learning trigonometry. About 60% of student learning outcomes in trigonometry have not reached the KKM, which is 70. Many factors caused the low student learning outcomes. one of them is the implementation of conventional learning models where only the teacher explains, and students are only listeners (Hidayati, 2017). Students learn more on the theoretical side only in teaching and learning activities. The teacher also explains a lot, and students only become listeners, so students are less active, get bored quickly, and daydream (not focused) when the teacher delivers the material. As a result, the material cannot be adequately understood. The use of less than the maximum media impacts the low results of mathematics lessons. the teacher is the only source of student learning, so students are not creative and not allowed to study more about the subjects they are learning. (Riski, 2016).

The other problem is the lack of student motivation to study mathematics. It is proven from a prime study that most students are still passive in learning; they don't want to do the exercise. The students' learning motivation in this school was low, too. About 60% students are of lack enthusiasm for learning mathematics. Students who have low learning motivation will impact feeling lazy to learn, reduce activity and result in low learning outcomes (Budiono, 2018).

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Learning motivation is always associated with engaging learning media and students' interest in learning. Good learning media can attract students' attention and increase student motivation (Budiman et al., 2018; Sahronih et al., 2020). Motivation can improve and guide the students to learn new things (Ghofur & Youhanita, 2020). Therefore, there needs to be a learning media that can generate motivation and increase the outcome of learning.

One way to do innovative learning is using learning media (Rachmadtullah et al., 2019; Sahronih et al., 2020). The development of technology requires teachers to be competent and realize student-centered learning continually. There are several methods to improve student learning outcomes. One is providing learning motivation to students (Syardiansah, 2016). Students' lack of motivation affects the student activity in the learning activity (Saepuloh & Ni'mah, 2021), so students are less enthusiastic about learning mathematics. Students who study with high motivation will learn actively, thoughtfully, and enthusiastically. They use interactive media as a learning resource to overcome students' difficulties and make the material easier to understand. The solution is to visualize the abstract material and increase student motivation (Astuti et al., 2020).

Various online media platforms can be used in the learning process, such as learning system management, interactive videos, interactive web, gamification, and online quizzes. All of which can be accessed by teachers and students online. But there are problems with gadgets and internet networks at the school where the evangelical research is being conducted. The

students of MA Assa'adah are forbidden to bring devices to school because most of them live in Pesantren. Internet connections are also very limited in schools. However, MA Ass'adah has two labs: the language and computer labs. And for this, researchers have the idea to create interactive learning media in the form of web-based multimedia that can be used offline in the lab. It is a multimedia-based interactive learning media in mathematics.

This media needs to be developed for teachers to offline innovative and exciting multimedia-based learning media. One of the uses of learning media is increasing students' learning outcomes and learning motivation. Therefore, learning motivation can be interpreted as guiding students to continue and act to the learning goal set by teachers in the learning process (Astuti et al., 2020). This media helps students comprehend trigonometry and gives the teacher an alternative teaching material of trigonometry interactive multimedia-based web offline.

According to Kustandi and Darmawan (2020), learning media is a way to help the teacher in the teaching and learning process, which has the function of sending a more explicit meaning or message so that learning objectives are appropriately sent and perfectly. Teaching media in education will help the students get information (Sahronih et al., 2019). Learning media is expected to increase motivation, make the subject matter clearer, and vary the methods. In addition, students will also do more learning activities, not just listen to the teacher. The teacher can also create learning in environment-based interactive learning media. So that learning is more interesting (Sahronih et al., 2020).

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Based on these problems, one of the best idea and solution is develop an interactive learning media using Articulate Storyline on trigonometry to improve students' motivation. It can also increase students' motivation to understand trigonometry. In addition, it is also expected to impact improving student learning outcomes. According to Voogt, Erstad, Dede, & Mishra (Lin et al., 2017), learning outcomes will be influenced by learning mode, curriculum design, and teaching media.

Articulate Storyline is a software developed by Articulate Global, Inc. to create great interactive learning, training content, and presentations based on slides (David et al., n.d.). The Articulate Storyline application's media preparation is exciting as an interactive learning medium (Yasin & Ducha, 2017). With html5 support, it is easy to publish content that can run on any platform, including online (web-based application), desktop, and mobile (David et al., n.d.). Besides text, users can easily add files to slides, such as images, audio, and video. Articulate Storyline is unique with adding a name and test variables. When combined, it can make it easier for teachers to see the terms of students who appear on the screen while evaluating.

Previous research about this topic is 1) Ghofur & Youhanita (2020) state that learning media can increase student motivation through interactive multimedia. It can also be selected as an alternative media Learning to improve students' learning motivation and implement and continuously improve the self-learning process. 2) Budiman et al. (2018) state that the students learning motivation has been high by students' desire always try to succeed in the learning activity and achieve good performance. Media can increase

student motivation by exciting students, giving realistic awards, expectations, and guiding student behavior. 3) Astuti et al. (2020) state that using website education as a medium makes the student/students feel motivated and enjoy and helps the students in the learning process. The introduction must be clear and written descriptively.

This research aims to develop feasible, practical, and effective interactive learning media using Articulate Storyline on Trigonometry to improve learning motivation.

RESEARCH METHODS

This type of study is research and development. The development model is the Thiagarajan model, known as the Four-D (4D) model. This model consists of four stages; they are: define, design, develop and disseminate (Thiagarajan et al., 1974).

The study is conducted at MA Assa'adah Cihambirung Karangsembung Jamanis Tasikmalaya. The product testing takes place at the MA Assa'adah Language Laboratory because this laboratory has adequate facilities and has 32 computers; this is quite a lot and supports multimedia. Sources of data in this development research are in the form of subjects and objects. The research subjects are experts (validators), students, teachers, and students related to this development research. The population in this study is the tenth grade of MA Assa'adah, which consists of five classes and is homogeneous. The research sample in this study is grade X IPA 1 MA Assa'adah, with 32 students. The sample was selected randomly. However, the number of students was limited to 50% due to the pandemic. So, the amount of sample is 16 students.

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The data collection techniques in this study are interview, observation, questionnaire, and test (pre-test and post-test). Based on the research objectives, the research instruments are interview sheets, observation sheets, validation instruments (questionnaire of media and material validity), and test. The data analysis techniques consist of validity, practicality, and effectiveness analysis. Validity analysis was carried out by collecting data of validity from each validator, then determining the average value of the total validation results. The questionnaire of validity was arranged by Likert scale with five intervals.

The calculation to obtain the percentage of eligibility using the following formula :

$$K = \frac{F}{N \times I \times R} \times 100\% \dots\dots (1)$$

Description:

K =Percentage of eligibility criteria

F =Total score of respondents'-answers

N =Highest score in the questionnaires

I =Number of questions in the questionnaire

R =Number of respondents

(Riduan, 2016)

After calculating the results of the eligibility percentage, the result of the percentage was interpreted based on the criteria in Table 1.

Table 1. The interpretation of validator assessment criteria

Percentage	Criteria
0% - 20%	Very unworthy
21% - 40%	Not worthy
41% - 60%	Enough
61% - 80%	Worthy
81% - 100%	Very worthy

(Riduan, 2016)

Based on Table 1, the learning media can be called suitable for use if the rate of all aspects in the questionnaire is more than 61% with worthy or very worthy criteria. For the next, the method to analyze practicality is to recap the questionnaire response data from learning media users, then determine the average value of the total user/student response results and convert the average value into a percentage. The result of percentage was interpreted to category in Table 2.

Table 2. The percentage category of user response questionnaire

Percentage	Criteria
0% - 20%	Not very good
21% - 40%	Not good
41% - 60%	Enough
61% - 80%	Good
81% - 100%	Very good

(Riduan, 2016)

The first analysis to conduct the effectiveness of media was the normality test. The normality test identifies whether the data obtained from the respondents are distributed normally or abnormally (Sugiyono, 2017). The normality test of money used is the Kolmogorov-Smirnov formula (Karson, 1968). The data is expected if the significance value is more than 0.05 ($p > 0.05$). The calculation of the normality test was carried out with SPSS. If the data distribution is normal, the statistical analysis used is a parametric statistical model with paired sample t-test. However, if the information is not normally distributed, use non-parametric statistics with Wilcoxon Signed-Rank (Suroso & M, 2021).

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RESULTS AND DISCUSSIONS

This research aim to produce interactive learning media on Trigonometry made with Articulate Storyline.

The Result of the Define Stage

This stage is carried out before starting the research. The place chosen to be the place of study is MA Assa'adah Jamanis. The student was forbidden to bring gadgets to school. Even though they can use devices at home, students who live in Islamic boarding schools cannot because they can get any widgets to boarding schools. But, MA Assa'adah has a language laboratory consisting of 32 computers. Besides, MA Assa'adah lacks an internet connection to support student learning.

Based on the observations and interviews, the students are less enthusiastic about learning mathematics because learning only uses textbooks. So, we need more interesting supporting media, such as media that can display more pictures, videos, and exciting learning evaluations. The core is to increase learning outcomes and student motivation to make the student active in education. Students' academic abilities vary widely with various learning styles and speeds. In this case, some students learn by reading text, listening to the audio, or watching videos. The rate also varies. Some students must not be able to understand trigonometry material in one lesson.

The selection of materials is adjusted to the needs of teachers and students and the competency indicators being taught so that they are appropriate and relevant. The subject matter in this research is trigonometry. This concept analysis includes analysis of essential

competencies 3.7, 3.8, 3.9, and 3.10 for the knowledge aspect, essential competencies 4.7, 4.8, 4.9, and 4.10 for the skill aspect, which is packaged in interactive media with the help of the Articulate Storyline application.

The Result of the Design Stage

According to the results of the front-end analysis, the condition of the device that can be used at MA Assa'adah is a computer in the language or the computer laboratory. In this study, the language lab was used to test. The development is focused on computer-based interactive media because students cannot bring smart-phones to school. Learning media is presented offline due to bandwidth limitations. This media was arranged by use Articulate Storyline application.

The reason is that the application can create web-based or interactive CD-based applications without understanding coding languages. And the result does not need the internet and only distributes the files to each computer. The researchers focused on learning media development for mathematics subjects at this stage. This stage includes making flowcharts and storyboards. Flowcharts are used to help design learning media, and storyboards represent milestones for expanding flowcharts.

The next step after get flowcharts is make a preliminary media design before the trial is carried out. The results of this stage are initial designs (prototypes) of learning devices which are drafts along with research instruments. The result of flowcharts and prototypes can be seen Figure 1 until Figure 5.

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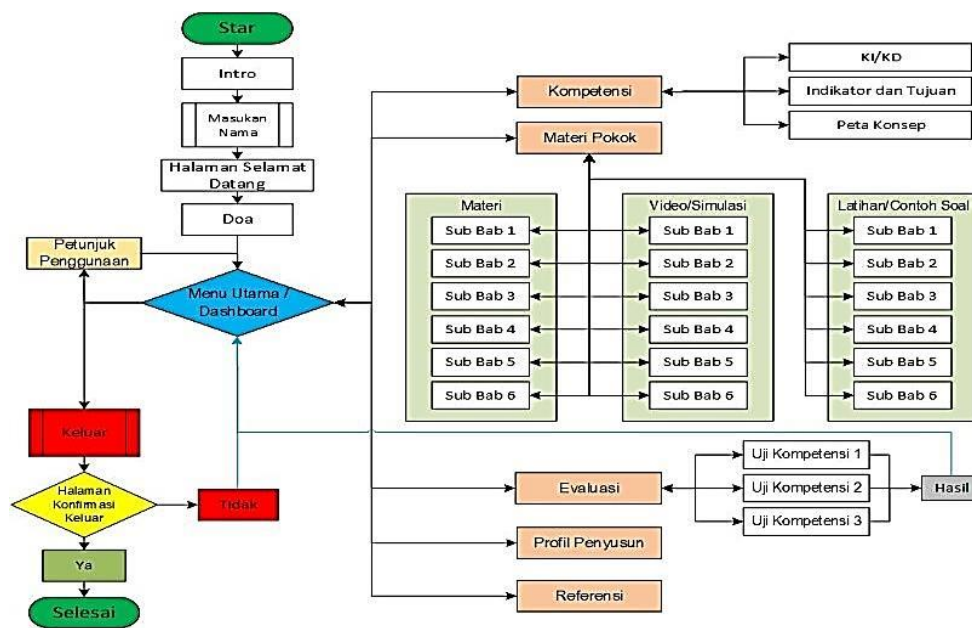


Figure 1. Flowchart of Interactive Media for Trigonometry



Figure 2. Snapshots of Intro Page



Figure 3. Snapshot of Dashboard Page

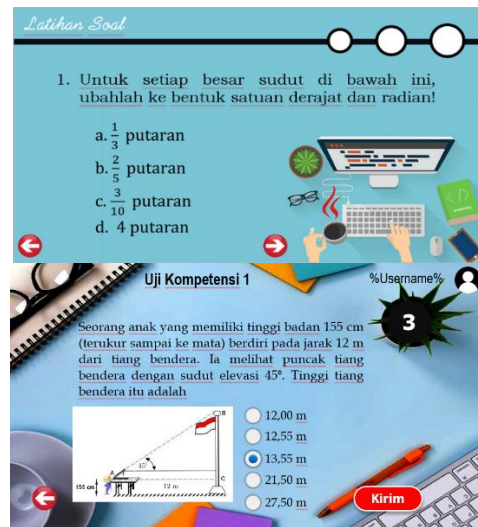


Figure 5. Snapshots of test and evaluation Page

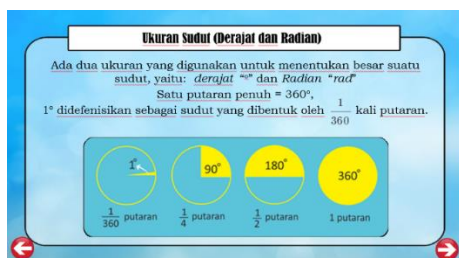


Figure 4. Snapshots of Material Page

The Result of the Development Stage

This stage is carried out in two steps: (1) Expert Appraisal. This stage is a validation technique for assessing the feasibility of interactive media that researchers have designed. This technique is divided into the validation of material and media experts. Mathematics teachers and mathematics

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lecturers carried out material validation. This validation is to determine the feasibility of the content quality and purpose. From the questionnaire, the quality of the content and the purpose of

the developed product obtained a presentation of 88% with the "Very Worthy" criteria. The results of material validation for each aspect can be seen in Table 3.

Table 3. Results of Material Expert Validation

Category	Percentage	Indicator
Accuracy	90%	Very worthy
Interest	90%	Very worthy
Completeness	85%	Very worthy
Balance	88%	Very worthy
Interest/Attention	80%	Very worthy
Justice	100%	Very worthy
Suitability to student situations	95%	Very worthy

The validation results by the material expert validator show that the indicators assessed on the aspects of the quality of the content and objectives above are Very Worthy. Based on the results of the material expert's validation, it can be concluded that the interactive learning media developed using Articulate Storyline is feasible.

Furthermore, media validation is carried out by lecturers and informatics teachers regarding technical quality. The technical quality questionnaire developed obtained a presentation of 87.50% with the "Very worthy" criteria. Meanwhile, the results of media validation for each aspect can be seen in table 4.

Table 4. Result of Media Expert Validation

Indicator	Percentage	Categorie
Legibility	88%	Very worthy
Easy to use	95%	Very worthy
Display Quality	87%	Very worthy
Answer handling quality	80%	Very worthy
Application management quality	85%	Very worthy
Documentation quality	90%	Very worthy

The validation results from the media expert validator's assessment show that the indicators assessed on the technical quality are "Very worthy." According to the media expert's validation results, interactive learning media is worthy of use. (2) Developmental testing; This stage tests the media in the intended environment. The things that are tested first are prerequisite software, resolution, and compatibility. Application testing is

done by sharing it with the computer of the language laboratory (Figure 6).



Figure 6. Media that has been distributed to the Client

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The learning media developed obtained student responses with a score of 85.21%. The score obtained from the student response conversion table is in the 81% - 100% interval with the

description “Very Good”. Thus, learning media can be said to be very practical. The results of material validation for each aspect are shown in Table 5.

Table 5. The Student’s Responses to Each Aspect

Indicator	Maximum Obtained		Percentage	Criteria
	Score	Score		
Provide learning opportunities	320	274	86%	Very good
Provide learning assistance and motivation	160	133	83%	Very good
Instructional flexibility	400	342	86%	Very good
The quality of the test and assessment	240	202	84%	Very good
Media have an impact on students	320	276	86%	Very good

Based on the post-test results, 1 out of 16 students could not reach the KKM. However, the percentage of classical completeness shows that the mastery of class X IPA 1 students is

94%, greater than 75%. Thus, the learning media developed in this study was declared effective. The results of the analysis of learning effectiveness using SPSS shown in Figure 7.

Pair 1		Mean	N	Std. Deviation	Std. Error Mean
		Pre_test	42,44	16	10,973
Post_test		78,56	16	6,164	1,541

Figure 7. SPSS result for Sample Statistics

This output shows the descriptive statistical results of each sample, namely the pre-test and post-test scores. The pre-test score obtained an average learning outcome or meant of 42.44. Meanwhile, for the post-test result, the average score of learning outcomes is 78.56. Because the pre-test score is less

than the post-test ($42.44 < 78.56$), so there is descriptively a difference in the learning outcomes between the pre-test and post-test, so it is necessary to interpret the paired sample t-test results in the paired samples’ test output to determine whether the difference is significant.

Pair 1	Pre_test & Post_test	N	Correlation	Sig.
		16	,803	,000

Figure 8. SPSS result for Sample Correlation

Figure 8 shows the correlation/relationship test results between two data and the correlation between the

pre-test and Post-Test variables. Based on the production, the correlation coefficient (Correlation) of 0.803 means

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that the correlation is solid and positive. The significance value (Sig.) is 0.000. Because of the importance of Sig. 0.000

greater probability of 0.05 ($0.00 > 0.05$), it can be said that there is a relationship between pre-test and post-test.

Paired Samples Test									
		Paired Differences							
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	Pre_test - Post_test	-36,125	7,051	1,763	-39,882	-32,368	-20,494	15	,000

Figure 9. SPSS result for Sample Test

Based on Figure 9, the t_{value} is negative -20,494. T_{value} is negative because the average post-test is lower than the average pre-test. In this context, a negative count can be positive. So the value of the t_{value} becomes 20,494. Next is finding the value of the t_{table} , where it can be searched based on the value of df (degree of freedom) and the significance of alpha over two. From the output above, it is known that the df value is 15 and $\frac{0.05}{2} = 0.025$. This value is used to find the t_{table} in the distribution of the statistical t_{table} . Then the value of t_{table} is 2.131. Thus, because the t_{value} is $20,494 > t_{table} 2,131$, there is a significant difference between pre-test and post-test, which means there is an effect of using interactive media developed by Articulate Storyline to improve learning outcomes for Mathematics subjects in Trigonometry.

From the three results above, it can be concluded that interactive media can improve learning outcomes, meaning that students' ability to understand trigonometry increases so that they can exceed the KKM. The interactive learning media developed is effective. This learning media can facilitate and increase student learning motivation.

Ghofur & Youhanita (2020) state that The development of interactive

multimedia can increase the student motivation as a learning innovation. The media can be used efficiently, and interactive multimedia developed can also be used as an alternative in media learning selection aimed to improve students' motivation for learning and implementation and simultaneously. Learning conditions that were initially stressful turned into fun. So that student are motivated. Interactive learning media or multimedia can assist teachers in creating interactive learning patterns.

The study results by (Budiman et al., 2018) indicate that learning media affects the student motivation in learning. The are correlation between learning media and the learning motivation of students. The traditional learning methods tend to make students bored with learning.

Astuti et al. (2020) state that students feel motivated, fun, and able to assist in learning by using interactive learning media. The students do not feel bored learning mathematics because there are differences from previous learning, which only uses classical methods. Students feel happy because this learning media is easy to use and contains explicit trigonometry. The students also can repeat the written and video material. The student situation in the learning process with interactive learning media is shown in figure 10.

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Figure 10. Student Situation in the Learning Process with Interactive Learning Media

The learning media is helpful because the teacher is helped and can guide students one by one. The subject teacher also stated that this interactive learning media is recommended to be used because it can foster motivation in students. Interactive learning media are considered relevant for their use today because the students are learning millennials who should be familiar with the help of technology. Besides, it makes students quickly bored during the learning process (Sahronih et al., 2019).

The use of interactive media can improve learning outcomes, meaning that students' ability to understand trigonometry increases to exceed the KKM. There is an increase in the number of severe students in learning. Thus, the existence of this learning media can overcome the problems that arise in the initial observations. After using Articulate Storyline's interactive media, there was increased motivation. Learning conditions that were initially stressful turned into fun. So that student are motivated. They also do not feel bored when in front of the computer. This interactive learning media is easy

to use, contains mathematical concepts and understanding, and can repeat written and video material.

Based on the student questionnaire, providing assistance and learning motivation obtained 83% or excellent results, and 86% could have a good impact on students. So, one of the uses of learning media is to increase learning motivation for students to take part in learning.

The impression of students using this interactive learning media is that they have the motivation to learn mathematics. Because using interactive media in the learning process can stimulate students' cognitive levels through several phases, including the degree of attention, retention, reproduction, and motivation (Sahronih et al., 2020).

Shalikhah (2017) states that interactive multimedia learning can make the learning process more exciting and easier to understand the material. This is done by combining and presenting various types of objects in one learning, namely multimedia-based learning media, so that the material can be digested by all students with multiple learning styles such as visual, audio, and kinesthetic.

The Result Dissemination Stage

The last step is dissemination. The dissemination stage distributes the product developed to be accepted by individuals and groups by users (teachers and students). This dissemination stage was carried out at the school/madrasah where the trial was conducted, namely at MA Assa'adah Jamanis Kab. Tasikmalaya provides a softcopy of interactive media files and guides to mathematics teachers.

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CONCLUSION AND SUGGESTION

Based on the research and development results that have been carried out, it can be concluded that the product in this research is learning media using Articulate Storyline in Trigonometry. The study uses the development research by the Thiagarajan model, known as the 4D model (Four-D Model), consisting of four stages. The first is “define,” the second is “design,” the third stage is “develop,” and the fourth is “disseminate.” According to material experts and media expert validation, the learning media set was declared worthy of use. An increase in student learning outcomes based on the average pre-test and post-test results. Then, the value of $t_{\text{value}} 20,494 > t_{\text{table}} 2,131$ shows a significant average difference between pre-test and post-test, which means that interactive media developed using Articulate Storyline improves learning outcomes for Mathematics.

Offline classes can be interactive using learning media that are also interactive. For schools with little gadgets and connections, teachers can use technology-based media that can be used offline, such as this developed media. Do not let face-to-face meetings make the teacher teach performance, only with a blackboard and markers or chalk. Engaging learning media and making students involved in the learning process automatically create interactive classroom conditions. For further research, it is necessary to continue developing interactive learning media for Trigonometry using Articulate Storyline or other authoring tools. Besides that, it is also to develop learning media with other materials besides trigonometry using Articulate Storyline.

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