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Development of Learning Videos for High School Mathematics Curriculum Subjects with Flipped Classroom Models to Improve Students' Critical Thinking Skills

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Abstract

During the current pandemic, students have difficulty understanding mathematical material, usually they are taught by lecturers face-to-face and now online, the obstacle experienced by students is that they feel that learning is not optimal because often the signal is not good and is not steady and cannot meet the lecturer. , to reduce this problem, it is necessary to make a video of learning material that will be delivered by a mathematics lecturer by the lecturer who teaches, the video is placed on youtube and the youtube link is given to students to study first for the upcoming meeting, this is in accordance with the flipped classroom model where students are asked to learn first the video made by the lecturer before being explained directly by the lecturer,It is expected that students are able to think creatively about video material made by their lecturers and students are able to analyze material deficiencies that have not been understood by them and then explained by their lecturers at the next meeting, while the research method used is using the ADDIE R & D model (Analysis, Design, Develop). , Implementation and Evaluation) which was carried out for 2 years with the analysis, design and develop steps in the first year and the implementation and evaluation steps in the second year, the output of this research is the copyright product of a video application learning material system of linear inequalities, linear equations and linear programming and Additional outputs are scientific publications in the European Journal of Educational Research indexed by Scopus Q3 with the link https://www.eu-jer.com/ who has been submitted and attended the ICDESS international seminar as a presenter, then based on the results of the validation of material experts and learning media experts, the average value is 92.5 percent, meaning that the learning video product for the system of linear inequalities, linear equations and linear programs is in the very category. suitable for use in learning high school mathematics curricular subjects, while student responses after using learning video products with a feasibility value of 87.82% are in the good category, from the results of expert validation and student responses, this learning video product is suitable to be used as a learning supplement in the classroom and amplified valueThen based on the results of the validation of material experts and learning media experts, the average value was 92.5 percent, meaning that the video product learning material for linear inequality systems, linear equations and linear programs was categorized as very suitable for use in learning high school mathematics curricular subjects, while student responses after using the learning video product with a feasibility value of 87.82% it is in the good category, from the results of expert validation and student responses, it shows that this learning video product is worthy of being used as a learning supplement in the classroom and reinforced by the valueThen based on the results of the validation of material experts and learning media experts, the average value was 92.5 percent, meaning that the video product learning material for linear inequality systems, linear equations and linear programs was categorized as very suitable for use in learning high school mathematics curricular subjects, while student responses after using the learning video product with a feasibility value of 87.82% it is in the good category, from the results of expert validation and student responses, it shows that this learning video product is worthy of being used as a learning supplement in the classroom and reinforced by the valuewhile the student response after using the learning video product with a feasibility value of 87.82% is in the good category, from the results of expert validation and student responses it shows that this learning video product is worthy of being used as a learning supplement in class and reinforced by the valuewhile the student response after using the learning video product with a feasibility value of 87.82% is in the good category, from the results of expert validation and student responses it shows that this learning video product is worthy of being used as a learning supplement in class and reinforced by the valuethe average posttest of the experimental class is x1 = 81.33 and the average of the control class is x2 = 70.59 with tcount of 4.29 and ttable of 1.78. Because tcount > ttable which is 4.29 > 1.78 then Ho is rejected. This means that classes that receive treatment with learning videos have better learning outcomes than classes with conventional learning.

Keywords: development, learning videos, flipped classroom, critical skills, creative abilities.

Introduction

Therefore, it is necessary to innovate learning, one of which is by making learning videos for each chapter of the material on the digital book for high school mathematics curricular courses that can be uploaded on the UT website as a supplement to high school mathematics curricular material, while the learning model that is in accordance with the learning video is one of the models flipped classroom which requires students to learn independently first. there are many studies on the effectiveness of learning videos that have a great influence, for example in developing mathematics learning videos assisted by social media Instagram as an alternative learning is very effective because Instagram provides convenience for students in learning mathematics material through videos that are

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packaged attractively and according to students' wishes [1], Then the effectiveness of the flipped classroom model using mathematics learning videos on concept understanding is shown that students are able to master 60 percent of the material uploaded in the learning video, so that when the learning process is in the virtual classroom, students only need 40 percent more to understand the uploaded material according to the standard of achievement of mastery of the material. 2], then with interactive multimedia-based video mathematics learning media students become enthusiastic about learning math material because it is interesting and easy to remember the way of thinking [3]. in the application of the flipped classroom model, it has been widely used in learning and is very effectively applied in online classes, It is shown that using the flipped classroom model with the help of power point and audio visual media in elementary schools is able to improve 70 percent of student learning outcomes completely [4], then students' problem solving abilities through the flipped classroom model in 21st century chemistry learning improve very well, especially students can preparation for practice by viewing learning videos with the flipped classroom model first [5]. Then in overcoming the problems of students of the Open University Mathematics Education study program in understanding the material for high school mathematics curricular subjects, an interesting learning video media will be made by applying the flipped classroom model in the learning process in the virtual classroom, this has been linked in the LPPM Open University research plan in 2021.

Literature Review

Video Learning Video is a medium for delivering messages including audio-visual media or viewing and listening media [6]. Audio-visual media or video can be divided into two types: first, equipped with sound and picture equipment functions in one unit, called pure audio-visual media; and second, the audio-visual media is not pure. Motion films, television, and videos belong to the first type, while slides, opaques, OHPs and other visual equipment with sound are the second type [7], learning videos are depictions or visualizations of the narrative of learning material and packaged briefly, in words Another learning video is a learning media that contains sound, images, motion and text and is packaged in a concise, clear and concise manner [8]. 2. Flipped Classroom Learning Model Flipped Classroom is a learning model that "reverses" the traditional method, where usually material is given in class and students do assignments at home [9]. The concept of Flipped Classroom includes active learning, student engagement, and podcasting [10], in the flipped classroom, the material is first given through learning videos that students must watch at their respective homes, on the other hand, classroom learning sessions are used for group discussions and doing assignments. with the lecturer acting as a coach or adviser [11]. Figure 2. Menu flow chart model flipped classroom 3. High School Mathematics Curriculum Material High school mathematics is a science that deals with or examines abstract forms or structures and the relationships between them at the high school level [12]. To be able to understand the structures and relationships, of course an understanding of the concepts contained in mathematics is needed [13], the definition or understanding of mathematics according to the IQF curriculum, namely: (1) Mathematics is an exact and organized branch of science systematically. (2) Mathematics is knowledge of literature review of not more than 1000 words by stating a state of the art and roadmap in the field being researched/technology being developed. The presentation of the road map can be in the form of a chart in the form of an image. Sources of relevant primary literature/references and by prioritizing research results in the latest scientific journals and/or patents. numbers and calculations. (3) Mathematics is knowledge of logical reasoning and dealing with numbers. (4) Mathematics is knowledge of quantitative facts and problems of space and form. (4) Mathematics is knowledge of logical structures. (5) Mathematics is knowledge of strict rules [14]. 4. Critical and Creative Thinking Ability Critical thinking can be interpreted as a process and ability used to understand concepts, apply, synthesize and evaluate information obtained or information generated [15], not all information obtained can be used as knowledge that is believed to be true to be used as a guide in action, and not always the information produced is correct information [16], then critical thinking is a high-level thinking skill and has been known to play a role in moral development, social development, mental development, cognitive development, and scientific development [17]. Creative thinking is a mental activity that produces something new as a result of development [18], then creative thinking is a mental activity to increase originality and insight in developing something (generating). produce or develop something new,

Method

Research Design

This research method is research and development (Research and Development). Research and development (Research and Development) is a research method used to produce certain products such as designs, models, prototypes of learning media, etc., and to test the effectiveness of these products [26]. The research model uses the ADDIE model development research design model. This model, as the name implies, consists of five main phases or stages, namely (A) analysis, (D) design, (D) development, (I) implementation, and (E) evaluation. The five phases or stages in the ADDIE model need to be carried out systemically and systematically [27], for the first year in the analysis, design and develop steps, while the second year in the implementation and evaluation steps.

Samples and Data Collection

The samples in this study were students of the Mathematics Education study program at the Open University and PGRI Semarang University students and the data were taken by random sampling

Analyzing of Data

Student response questionnaire data, expert validation data and student test data were t-tested on their critical and creative thinking skills, while the validation used an average percentage with quantitative descriptive

Result And Discussion

In this study, a video product for learning high school mathematics curricular subjects was produced with a flipped classroom model which was developed using the ADDIE model. For the first year, three stages were carried out, namely Analysis, Design, Development. The results of product development are described in detail according to the ADDIE development procedure (Sugiyono; 2010). as follows.

Analysis

At this stage of analysis, an analysis has been carried out regarding the problems of learning high school mathematics curricular subjects at the Open University in the Mathematics Education study program which shows that 70 percent of students are still weak in understanding high school mathematics curricular subjects, especially those related to material. Linear Equation and Linear Inequality Systems, as well as their Linear Program are still below 70 based on the results of the initial pretest, then the students stated that during the 2020-2021 pandemic, 90% of Open University students really need learning media that can improve students' critical and creative thinking skills, especially material System of Linear Equations and Linear Inequality, this is in accordance with the research of Saputra, MEA, & Mujib, M. (2018) which shows that mathematics education students are still weak in mastering the material for systems of equations and linear inequalities. This is because this material is still packaged in conventional learning. and still use simple learning media such as powerpoint only, therefore it is necessary to make learning video media containing high school mathematics curricular material whose recordings are uploaded on youtube and can be accessed by students anytime and anywhere, so that students fit the flipped classroom model where students are asked to study independently at home before offline or online learning at a meeting led by the lecturer.

Design

After the learning video product is finished, a focus group discussion is held regarding the design display and the depth of the material displayed, namely the system of linear equations and inequalities, the results of the focus group discussion show that students need to be given practice to determine the position of the system of linear equations and inequalities with animation and other mathematical software. so that they understand the mathematical concepts better. This is confirmed by research The results of the focus group discussion show that students need to be given practice to determine the position of a system of linear equations and inequalities with animations and other mathematical software so that they understand the mathematical concepts better. This is confirmed by research The results of the focus group discussion show that students need to be given practice to determine the position of a system of linear equations and inequalities with animations and other mathematical software so that they understand the mathematical concepts better. This is confirmed by researchSuseno, PU, Ismail, Y., & Ismail, S. (2020), which shows that students' critical and creative thinking skills become further improved if they are given a touch of renewable media based on learning videos that are packaged in attractively based mobile media that are attractive and practical to use. students, then Akbar, RRA (2018) by making learning videos independently by the lecturers, it is very interesting for students to study the material for systems of equations and linear inequalities in a relaxed and fun way because they can learn independently.

Image 1. Front view of learning video products

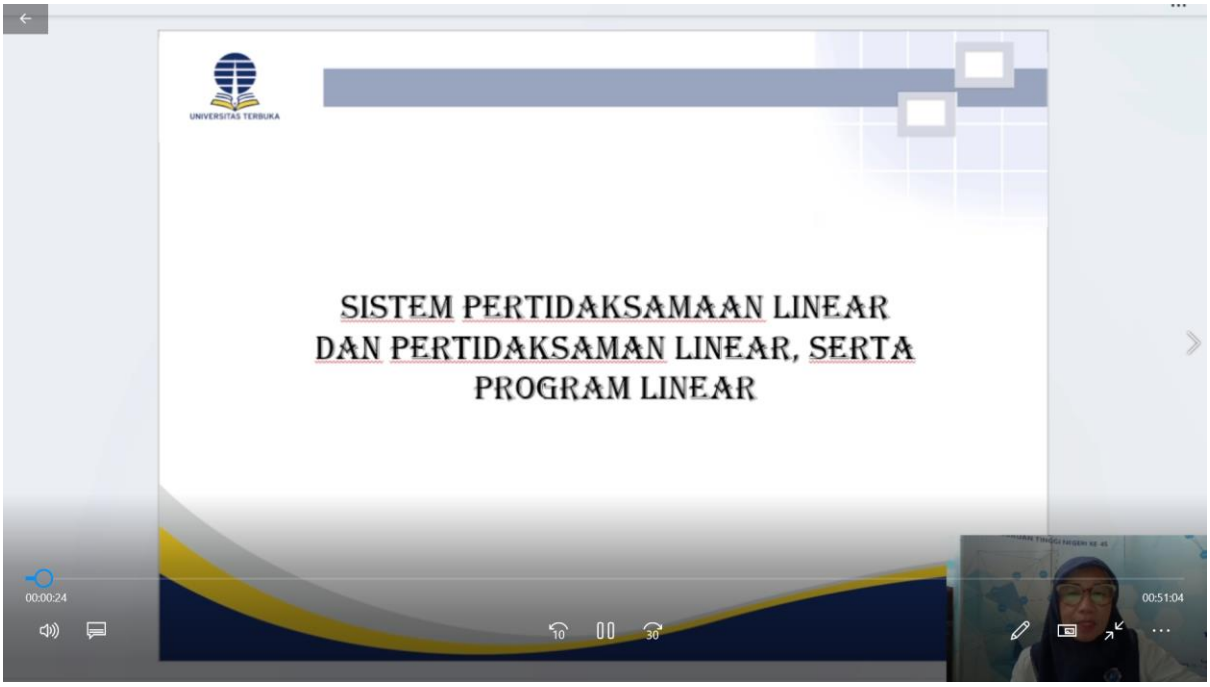


Figure 2. Display of mathematics curricular subject material packaged in learning videos

Development

In this development stage, the framework that has been designed is realized so as to produce a product that can be implemented. At the development stage of the Geometry Virtual Lab media, after the android-based media is complete, it is validated by media experts and material experts by the validator to get input and evaluate according to the input given by the validator. Furthermore, the Virtual Reality-based media is revised according to the input given by the validator to improve the product.

In this development stage, a learning video product has been produced that has been adapted to the results of a focus group discussion between lecturers and students which includes the design of high school mathematics learning video media and the depth of high school mathematics material taken. Then the product before being tested in the field, expert validation is carried out first including high school mathematics material experts and video-based learning media experts.

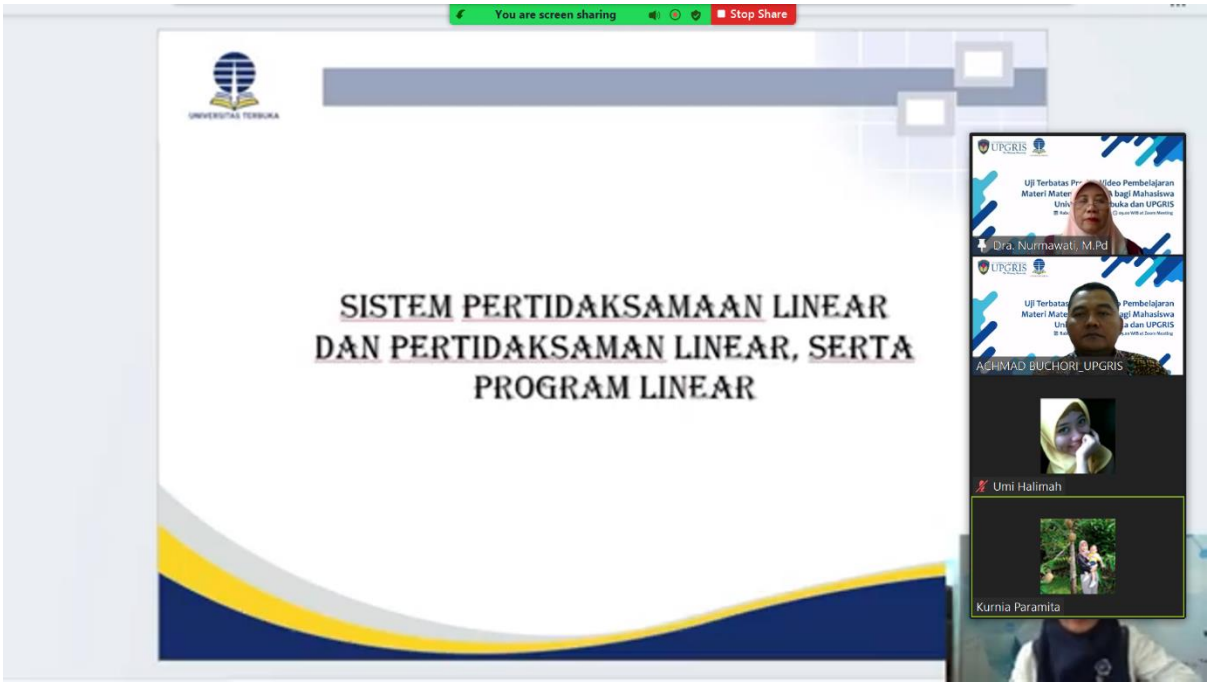
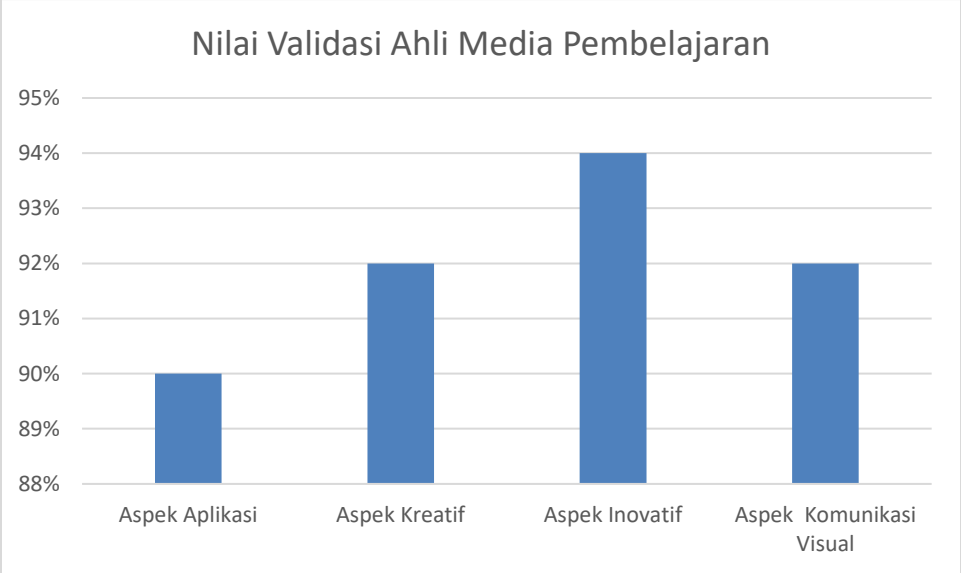


Figure 3. The process of validating learning media for high school mathematics curricular learning video products by Dr. Achmad Buchori, M.Pd.

Figure 4. The process of validating the product material for high school mathematics curricular learning videos by Dr. Lusi Rachmiazasi Masduki, M.Pd.

(7) this learning video product can be applied properly and in accordance with the KKNI material, (8) students can solve questions about systems of linear equations and inequalities in a sequential and interesting manner, (9) users will have no difficulty in operating this learning video product, (10) this learning video product is able to improve students' creative and critical skills by playing the material repeatedly until they understand it, from the validation results it is shown that the average result of the learning media expert assessment is 92, which indicates that this high school mathematics curricular learning video product is reviewed From the feasibility of the design of this learning video product, it is very suitable to be used in learning. This is in accordance with the research of Maemanah, S., Suryaningsih, S., & Yunita, L.

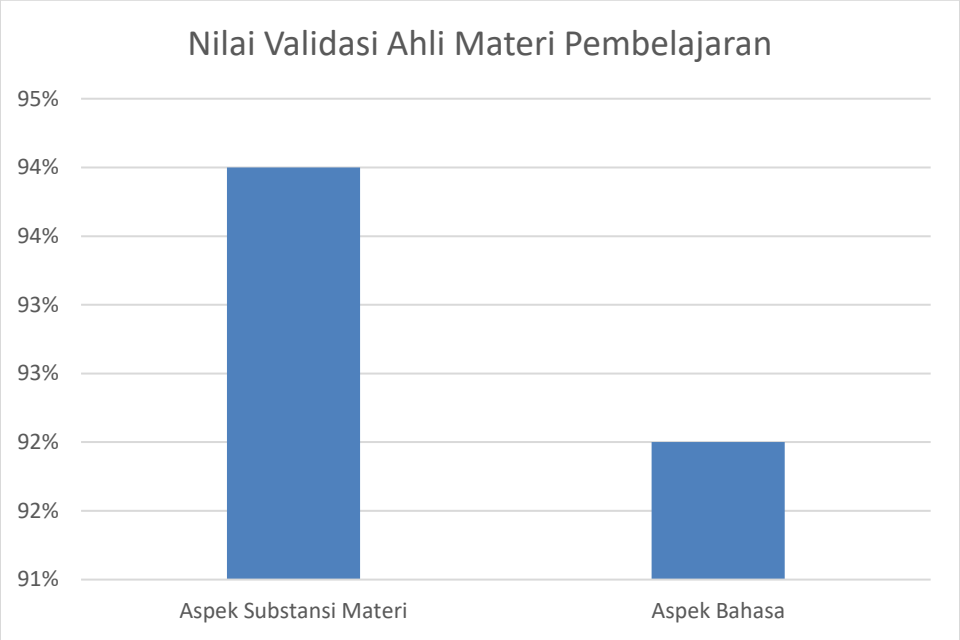
Table 1. Learning Media Expert Validation Results on Learning Video Products



Meanwhile, based on the results of material expert validation, the following results were obtained: (1) this learning video product is suitable as a virtual supplement for high school mathematics curricular material, (2) concepts related to this SPLDV material can be understood virtually, (3) learning video interesting to use in other courses, (4) the menus on the learning video product can be used in a cool and fun way, (5) this SPLDV material can be linked to students' critical and creative thinking skills, (6) the questions that have been there needs to be related to the context of the latest SPLDV problems, (7) this learning video product can be applied properly and in accordance with the KKNI material, (8) students can solve questions about SPLDV sequentially,(9) it is not difficult to operate this learning video product, (10) this learning video product is able to improve students' creative and creative thinking skills, based on the expert assessment of SPLDV learning materials shows that the material presented in this learning video media is very feasible to be applied in eye

learning high school mathematics curricular lectures with an average value of 93%, meaning that the SPLDV material presented is very suitable for use in learning. This means that the SPLDV material presented is very suitable for use in learning. This means that the SPLDV material presented is very suitable for use in learning.

Table 2. Results of Expert Validation of Learning Materials on Material Depth Learning Video Products



Implementation

At this implementation stage, a limited test was carried out for students of the mathematics education study program from the Open University and PGRI University Semarang using learning video products in learning high school mathematics curricular lectures with SPLDV material by first downloading the video on youtube then taking a pretest before high school mathematics curricular learning and post-test. test after following the lesson using this learning video. This implementation activity is carried out online using Zoom meetings.

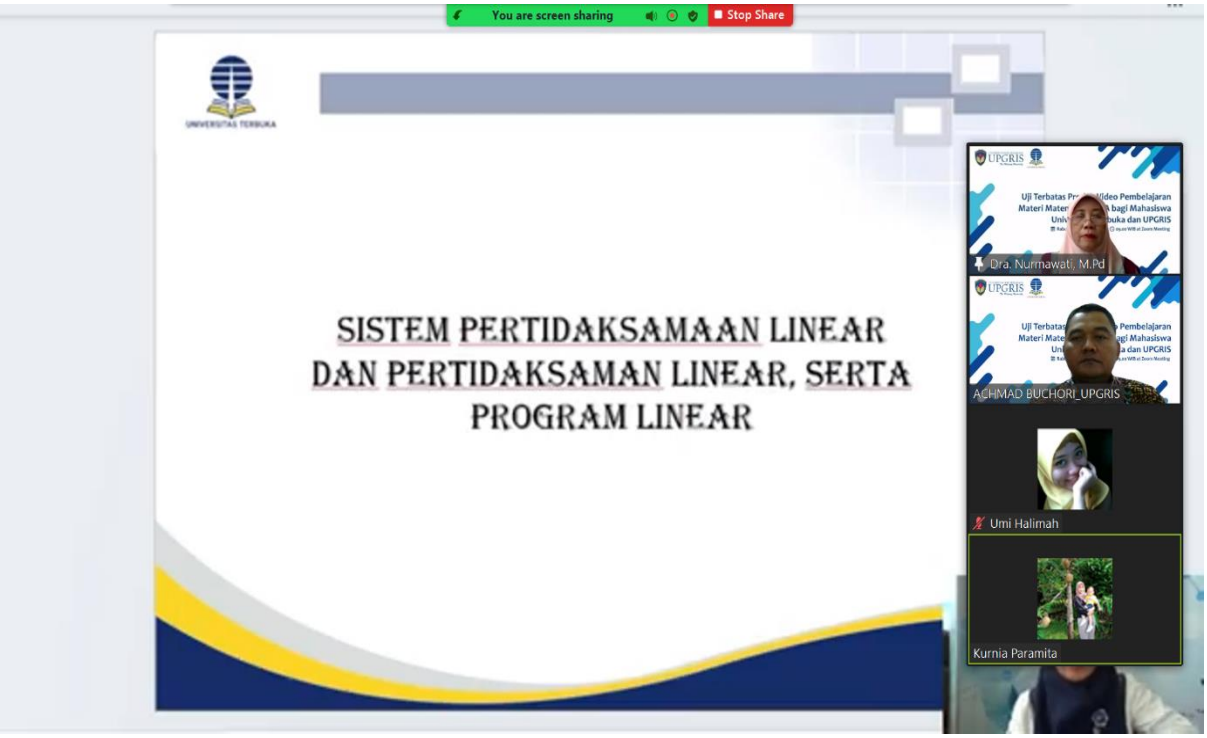


Figure 3. Implementation of limited test of learning video products at UT & UPGRIS

5. Evaluation

In this research and development, an evaluation of the quality of learning video products has been carried out and an evaluation of the impact of the use of learning videos at the University of PGRI Semarang, as follows.

Evaluation of the Quality of Teaching Media

Based on the results of the questionnaire evaluation of learning video teaching media were given to learning media experts, learning material experts, and students who took part in the trial. This evaluation can be used as input for the revision of the learning video product. Based on the results of the validation of material experts and media development experts, the learning video product is valid and feasible to use by meeting the criteria for material and media indicators with an average score of 92.5, which means that the virtual geometry lab product is very feasible to use.

Evaluation of the Impact of Using Video Learning for High School Mathematics Curricular Courses

This evaluation is used as a consideration in the use of video-based learning media in learning activities in online or offline classes. One of the impacts of using this learning video media can be seen from the post test results, namely 86.33 which is in good criteria, with previously given a pretest of 75.25.

The implementation of a limited trial was carried out at the Open University and PGRI University Semarang by taking the fifth semester students of class 5B as the experimental class and class 5A as the control class. Post-test data analysis was conducted to determine whether the experimental class and control class, have differences between conventional learning and learning using learning media using learning videos. Furthermore, the researchers analyzed the post-test data that had been carried out on students in grades 5A and 5B.

The steps used to analyze the post test data are as follows.

Normality test

To calculate the normality of the initial data using the Liliefors test with a significant level of 5%. The hypotheses and criteria in the normality test are as follows.

Ho : L0 < Ltable then the population is normally distributed

Ha : L0 > Ltable then the population is not normally distributed

The following results were obtained.

Table 3. Liliefors Uji Test

Class	N	L0	Ltable	Decision
Experiment 5B	25	0.154	0.173	Normal distribution
5A Kontrol control	25	0.147	0.184	Normal distribution

From the table it is clear that L0 < Ltable in the control class and experimental class with a significant level of 5% with n1 = 25 and n2 = 25 so that Ho is accepted. This means that the sample from the experimental class and the control class comes from a sample that is normally distributed.

Homogeneity Test

Homogeneity test is used to test the similarity of two variances. From calculations with MS. Excel obtained Fcount = 1.52, with alpha = 0.05 and dk numerator (25 – 1= 24), dk denominator (25 – 1= 24), so F(0.05)(24,21) = 2, 52. The test criteria accept Ho if Fcount < Ftable. Because Fcount < Ftable which is 1.52 < 2.52 then Ho is accepted, so it can be concluded that the

variance between groups is homogeneous (same).

t test

The effectiveness of android-based learning media using learning videos was tested using an experimental design, namely Posttest Only Control Design. In this design there are two groups, namely the experimental group and the control group. This experimental design was used to compare student learning achievement between the experimental group and the control group with the expectation that the experimental group's achievement was better than the control group.

The hypotheses used in this study are as follows.

Ho = The result of learning mathematics using learning media based on video learning

there is no difference with conventional learning models.

Ha = Learning outcomes of mathematics using instructional video-based learning media

better than conventional learning models.

To find out which learning is better, the t-test test (right side) is used using the following formula.

$$t = \frac{\left(\overline{X_1} - \overline{X_2}\right)}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$$dengan \quad s^2 = \frac{(n_1 - 1)s^2{}_1 + (n_2 - 1)s^2{}_2}{n_1 + n_2 - 2}$$

Based on calculations with MS. Excel obtained the experimental class average, namely x1 = 81.33 and the control class average, namely x2 = 70.59 with n1 = 25, n2 = 22 and s = 13,407 so that t count = 4.29. The result of t count is compared with t table. From the distribution list t with probability 0.95 and dk = 25 then t 0.95 is 1.78. From the calculation obtained tcount of 4.29 and ttable of 1.78. Because tcount > ttable which is 4.29 > 1.78 then Ho is rejected.

Based on the above calculations because Ho is rejected, it can be concluded that the results of learning mathematics using android-based learning media using learning videos are better than conventional learning models. This proves there is a difference in learning achievement because the lecturer uses two different treatments between the control class and the experimental class with the average value of the experimental class that is x1 = 81.33 and the control class average is x2 = 70.59. From the results of learning achievements it shows that students are enthusiastic in using Android-based learning media using learning videos because this is a new thing for students. They feel that there is a medium that makes it easier for them to understand the material on systems of linear equations and inequalities. This is reinforced byKencanawaty, G., Febriyanti, C., & Irawan, A. (2020) ywhich shows that the integration of learning video media is one of the adaptations of new habits during the pandemic, so that students better understand the material that is equated by their lecturers, thenMuthy, AN, & Pujiastuti, H. (2020). It also strengthens that the use of technology in learning mathematics with video-based e-learning media makes learning easy at home.

Student Response Results

Students respond to this learning video-based learning media by filling out a questionnaire given by the researcher via the google form link for students to fill out. Questionnaire links were given to students after students finished using learning video-based learning media. This is done so that researchers know how well this video-based mathematics learning media is used for students. The questionnaire filled out by students has five scales with the following criteria.

Score 5: Strongly Agree (SS)
Score 4: Agree (S)
Score 3: Disagree (KS)
Score 2: Disagree (TS)
Score 1: Strongly Disagree (STS)

The assessment criteria are 10 questions. The results of the analysis of student responses for each question are presented in the following table.

Table 4. Student Response Questionnaire Results

NO	CRITERIA	AVERAGE	PERCENTAGE
1	I am very interested in Learning Videos on High School Mathematics Curriculum Courses	4.49	89.8
2	I can understand Learning Videos on High School Mathematics Curriculum Courses	4.4	88
3	The application of giving quizzes on Video Learning for High School Mathematics Curriculum is not boring	4.44	88.8
4	With the High School Mathematics Curriculum Learning Video, learning is not boring	4.48	89.6
5	Video Learning of the High School Mathematics Curriculum Course looks interesting from a visual and audio perspective	4.48	89.6
6	I became motivated to study again with the High School Mathematics Curriculum Learning Video	4.24	84.8
7	Learning Videos for High School Mathematics Curriculum Courses can be easy to understand and understand	4.38	87.6
8	Learning Videos for High School Mathematics Curriculum Courses are easy to access using a smartphone or computer	4.37	87.4

9	Learning Videos for High School Mathematics Curriculum Courses are useful in lectures	4.36	87.2
10	Video Learning of High School Mathematics Curriculum Courses can improve students' cognitive abilities and learning independence	4.27	85.4
AVERAGE		4,391	87.82

From the calculation above, the student response is obtained with eligibilityLearning video mediaby 87.82% by students. After converting with scale conversion table, mediaLearning video mediaare in the range of 81% - 100%. So placing the position on the criteria is very good.

The percentage score of each student response criteria can also be seen in the form of a bar chart in Figure 6 below:

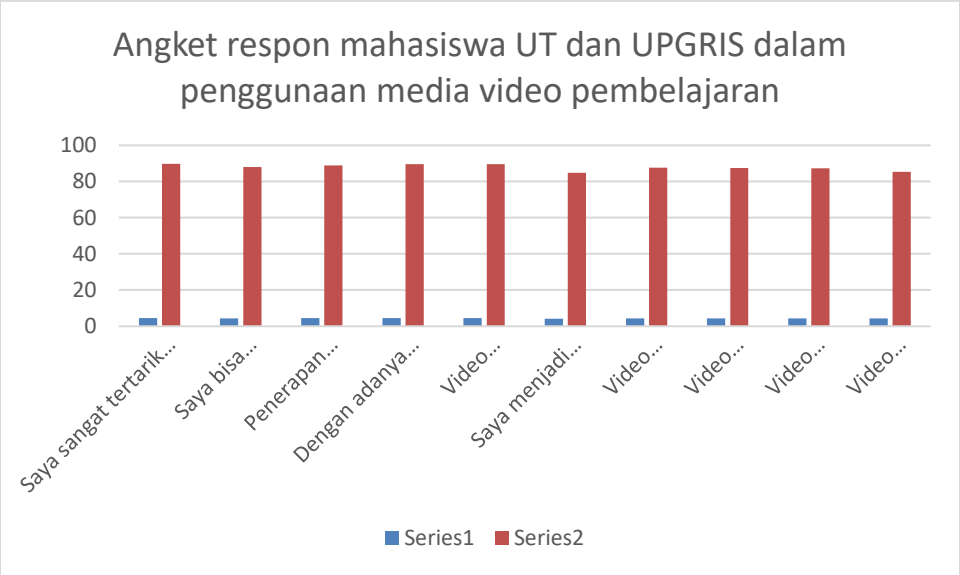


Figure 6. UT and UPGRIS student responses to the use of learning video media

Based on the response data from the Open University and PGRI Semarang students, it showed that 87. 82 percent of students were greatly helped by the learning media for high school mathematics curricular subjects to increase students' critical and creative thinking skills in learning SPLDV material. This is reinforced by Yanuarto WN (2018) who shows that with a flipped classroom assisted by video learning, students become more independent, thenRosiyanti, H., Adriansyah, AF, Widiyasari, R., & Dewi, NS (2020)explained that the use of mathematics learning videos in class VII SMP made students' perceptions of mathematics more positiveKusumaningrum, B., & Wijayanto, Z. (2020) confirmed that online learning in mathematics learning can have maximum results if the teacher uses media that is in accordance with the material being taught.

Conclusion

Based on the results of the validation of material experts and learning media experts, the average value is 92.5 percent, meaning that the video product learning material for linear inequality systems, linear equations and linear programs is categorized as very suitable for use in learning high school mathematics curricular subjects, while student responses after using a learning video product with a feasibility value of 87.82% is in the good category, from the results of expert validation and student responses, it shows that this learning video product is feasible to be used as a learning supplement in the classroom. Reinforced the posttest average value of the experimental class is x1 = 81.33 and the control class average is x2 = 70.59 with tcount of 4.29 and ttable of 1.78. Because tcount > ttable which is 4.29 > 1.78 then Ho is rejected.

Limitations

The research is limited to high school mathematics curricular subjects, so it is necessary to develop more learning videos to supplement other courses

Acknowledgments

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