



DEVELOPMENT OF LEARNING VIDEOS FOR JUNIOR HIGH SCHOOL MATH SUBJECT TO ENHANCE MATHEMATICAL REASONING

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ABSTRACT

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This study aimed to develop Mathematics learning media in the form of learning videos in order to enhance the reasoning abilities of students of Mathematics Education Study Program. This study used the development model to construct products in the form of learning videos on topics like Surface Area of Cuboid, Cube, Prism and Pyramid. To achieve this purpose, the ADDIE, Analyse, Design, Development, Implementation and Evaluation, development model was used. In this study; the steps conducted only reached the Development stage. Based on the validation of media experts, the percentage of the feasibility of learning media obtained was 95.15%. After being converted into a scale conversion table the percentage of the achievement level of 95.15% was in very good criteria. This proved that the learning video on the material surface area of the Cuboid, Cube, Prism and Pyramid were feasible to be applied in learning. Then, it was validated by material experts and based on expert validation, in terms of media aspects, material substance aspects, and learning design aspects which was scored at 90.86%. After being converted to a percentage scale conversion table the level of achievement of 90.86% was again in very good criteria. This led to conclude that the learning videos of the material surface area of Cuboid, Cube, Prism and Pyramid were feasible to be applied in research by making improvements in the order of material delivery.

Contribution/Originality: This study contributes to the existing literature related to the development of instructional media such as learning videos as Mathematics learning media to enhance the reasoning abilities of students of Mathematics Education Study Program at Universitas PGRI, Semarang.

1. INTRODUCTION

Mathematics in Higher Education plays a role in training students to think logically, critically, and practically, and to be positive and creative in spirit (Suherman, 2001). This competency is needed so that students can possess the ability to manage, obtain, and use the information to survive in an ever-changing, uncertain and competitive situation.

According to The NCTM (2000) there are five abilities that scholars/ students must possess about learning Mathematics, namely: problem-solving, reasoning, communication, connection, and representation. NCTM (2000) also states that these competencies must be developed in students at all levels. Historically, it has been observed that such abilities are ignored while teaching mathematics at secondary school levels. For instance, there is no formal evidence of teaching theorems in geometry classes. Similarly, reasoning is often set aside because lecturers

or teachers always struggle and remain engrossed in preparing scholars/ students for challenging situations by emphasizing the need for procedural competence and speed.

The report from Trends in the International Mathematics and Science Study (TIMSS) (Sumarno, 2015) in 2015, found Indonesian students ranked 45th out of 50 countries. The low ability of Indonesian students in mathematics is also reflected in the report of Program for International Student Assessment (PISA) (Rasiman, 2016) which publishes the results of a survey of mathematics learning achievements for school students in 65 countries, and Indonesia ranks 335.

The low mathematical reasoning ability of pre-service teachers can be seen from the results of observations made in the Mathematics Education Study Program at Universitas PGRI, Semarang. The pre-service teachers seem not to have been able to express an argument for problem-solving when the lecturer asks directly about a problem. In one of the interviews, a pre-service teacher confessed: "I can understand the questions given by the lecturer in the class and I finish using the concepts in Mathematics but I have difficulty explaining when asked the underlying arguments in finding answers to the questions and concluding answers to the questions". When working on the practice questions given by the lecturer, the pre-service teachers also find it difficult to determine the steps for solving a problem. This is evidenced from the results of the Mid-Term Test of the Junior High School Mathematics Subject in the even semester, when only 30% of pre-service teachers achieved grades above C or obtained scores in the range of 60-64.

Mathematics Learning videos are one of the media that can be a source of acquiring knowledge for pre-service teachers because these videos can help them to add information about the concepts learned. However, the learning videos that are in circulation still have some disadvantages, namely in terms of appearance or usefulness as they have failed to construct students' mathematical reasoning. Pre-service teachers are not accustomed to constructing concepts in mathematics independently; therefore, a few students may only memorize mathematical material but cannot know the interrelationships between concepts and are less capable of applying them in real life.

To overcome this problem, researchers developed a mathematics learning video to enhance students' mathematical reasoning abilities. With the use of this Learning Video, it is expected that students can construct arguments or proofs and it can become one of the alternatives to deliver mathematical study material in order to enhance students' learning outcomes. The Learning Video is titled as " Junior High School Mathematics " and includes components of learning that stimulate mathematical reasoning abilities.

2. LITERATURE REVIEW

2.1. Mathematical Reasoning

Mathematical Reasoning is one of the important abilities that must be developed in the learning of mathematics, but in reality, this ability is often ignored. Mathematical reasoning is needed in drawing conclusions in arguments and develop a particular way of thinking in students. It helps them to understand the relationship between two things or more based on certain characteristics or laws that are recognized by truth, using certain steps that should end with a conclusion.

Mathematical questions can be created in stages which include exploring and recalling: facts, principles, and concepts, practicing exercises and skills, solving problems, and investigating. One thing that also needs to be considered in an effort to prepare qualified pre-service teachers is to pay attention to hard and soft skills. Intra-personal and interpersonal intelligence of individuals are influenced by habits and behaviors as long as they act like individuals and pursue pre-service teachers' education.

Sumarno (2015) pointed out that the indicators of students who have mastered mathematical reasoning abilities are evidenced in (1) Drawing logical conclusions; (2) giving explanations using pictures, facts, characteristics, existing relationships; (3) Estimating answers and process solutions; (4) Using relationship patterns to analyze, make analogies, generalize, and compile and test conjectures; (5) Submitting examples to opponents ; (6)

Submitting rules of inference, checking the validity of arguments, and making valid arguments; (7) compiling direct evidence, indirect evidence, and proof by mathematical induction.

In addition, the technical regulations of the Directorate General of Primary and Secondary Education, Ministry of National Education of Indonesia required that students having mathematical reasoning ability should have the ability to submit suspicions, manipulate mathematics, draw conclusions, compile evidence, give reasons or evidence of the correctness of the solution, draw conclusions from statements, examine the validity of an argument and find patterns or characteristics of mathematical symptoms to make generalizations.

2.2. Relevant Prior Research

Rasiman (2016) studied the Development of Learning Videos for Grade VIII Junior High School Students based on K-13 Curriculum and found that the validation results by material experts found an average rating of 85.93% and the media received an average rating of 91.82% which meant that they were included in the Very Good category. From the results of expert validation, it was concluded that the learning video in the congruence material was suitable for use in learning. The results after using the learning video media were so significant that this media helped students achieve Mastery Learning scores of 7.5 for all 37 students in the Semarang City Junior High School. Prasetyowati (2013) in her research entitled the Development of Reasoning Capability and Mathematical Communication Ability of Teachers and Pre-service Teachers of Mathematics used Didactical Design Research (DDR) method and produced assessment instruments for pre-service teachers in microteaching courses where each learning was guided by mathematical communication skills with the goal to teach math subjects.

Bozkus (2018) examined Analyzing Middle School Mathematics Teachers' Understanding of Reasoning. This research was conducted using phenomenological design, which was one of the qualitative research methods. This research was conducted with a total of 16 high school math teachers who served in different public schools in 2016-2017 academic year. This study used an interview instrument consisting of four open questions to determine a teacher's theoretical and practical understanding of mathematical reasoning. This study used content analysis methods for data analysis. As a result, it was understood that a majority of secondary school mathematics teachers did not have comprehensive and adequate knowledge and views on mathematical reasoning when they analyzed how to define, exemplify, and support mathematical reasoning. Because it appeared that mathematical reasoning meant only making explanations, justifying and producing different solutions to a problem according to them. It is important that teachers must broaden their views on mathematical reasoning to support their students' reasoning well.

Finally, Kurucova (2018) examined the Application of E-learning Methods and their Efficiency in the Process of Teaching English for Specific Purposes, especially in the fields like media and journalism. It was rather a new phenomenon in Central Europe. The experiments conducted in this study focused on the efficiency of e-learning and blended-learning. The study worked with three groups of students with a variety of online education modes used in each group. The first group (18 students) was educated through pure e-learning, the second group (20 students) was taught through the classic face-to-face method, and the third group (18 students) through the blended-learning approach. Online education modes included interactive webinars with native speakers who provided direct feedback on students' assignments. In media / journalism study programs, blended-learning mode seemed to be the most efficient. By comparing the results of pre-tests with post-tests it was possible to determine language skills that were improved in three test groups, which included reading, speaking, listening and vocabulary which increased significantly in the blended-learning group.

2.3. Learning Media

Media originally comes from Latin and is the plural form of "Medium" which literally means "Intermediary" or "Introduction." It is an intermediary or introduction to the source of the message with the recipient of the message.

In teaching and learning process in the classroom, media means as a tool that serves to channel knowledge from teacher to students. The smooth application of learning model is more or less determined by the learning media used. The use of learning media in quantitative and qualitative research is also an important measure in the process of proving hypotheses.

In line with the development of technology, all media forms including audio, visual, projected still media and projected motion media, can be used simultaneously through a single tool called Multi Media. For example, today computer applications are not only projected motion media, but a mix of all types of media that are interactive. The main criteria in the selection of media are that the media must be adapted to the learning objectives or competencies to be achieved. If the learning objectives are motoric, film and video media can be used. In addition, there are other criteria that are complementary, such as cost, appropriateness, the state of the students, availability of resources and technical quality (Sadiman, 2008). Because the learning media used in learning activities can affect the effectiveness of learning, the media for this study was selected in the form of educational videos.

Using audio-visual materials in the classroom is not something new. Filmstrips were first studied during the World War II as a training tool for soldiers. Since then educators have recognized the power of audio-visual materials to capture the attention of learners, in order to increase their motivation and enhance their learning experience (Cruse, 2017).

2.4. Junior High School Math Subject

The Junior High school Math Subject is a compulsory subject for students of the undergraduate Mathematics Education Study Program at the Universitas PGRI Semarang. The course consists of Junior High School Mathematics subject consists of integers, rational numbers, forms of Algebra, social arithmetic, comparisons, equations and inequalities of two variables, sets, relationships and functions, strings and rows, lines and angles, Triangle, Pythagoras theorem, Quadrilateral, Circle, Congruent flat building, Build space and its elements, opportunities and statistics.

2.5. Development of Learning Video of Junior High School Math Subject to enhance Mathematical Reasoning

Gardner's theory showed how to convey subject matter in order to affect an individual's ability to learn, and how lecturers or teachers need to implement it. Intelligence is taken into account when planning the learning of this subject. Communication skills are also expressed as the ability to analyze and evaluate information. Critical thinkers raise important questions and problems, formulate them clearly, collect and assess relevant information, use abstract ideas, be open-minded, and communicate effectively with others. Duron (2006) stated that reasoning abilities can be grown through virtual learning and teaching in the classroom. Virtual learning is referred to as the use of the learning videos.

3. RESEARCH METHODS

This research has used the development model to conduct the research. The model was the development of a mathematics learning media in the form of learning videos for Junior High School Math subject. The videos produced in this study were learning videos on the subject topics like Surface Area of Cuboid, Cube, Prism and Pyramid. This study used the ADDIE Development Model, namely Analysis, Design, Development, Implementation, and Evaluation. In this study, the steps were restricted only reached up to the development stage. Data analysis was used to analyze the results obtained in the study. The data analysis technique used in this study was expert validation data analysis. The results of the analysis of the average value of the validator on the learning video were used as input material to revise the learning videos.

4. RESULT AND DISCUSSION

Based on the learning system design procedure using in the ADDIE Development Model of Dick and Carey, the first 3 stages Analysis, Design and Development, only were carried out in the first year .

The analysis step consisted of two stages, namely Performance Analysis and Needs Analysis. In the Performance Analysis stage, the researchers clarified with the lecturer whether the lecturers' performance problems needed a solution in the form of developing learning media or improving learning media in the form of videos. This study was conducted with second semester students of Junior High School on their Maths subject . From the results of interviews with lecturers obtained during the Junior High School Mathematics lecture process, it was revealed that lecturers and students used teacher books and student books issued from the Education Ministry and from the Semarang Deliberation Subject Teacher.

At the Needs Analysis stage, researchers determined the competencies that students needed to learn and improve performance or learning achievement. The researchers identified the general purpose of learning in the Junior High School Math Subject. Junior High School Math Subject was a compulsory course for students of the Undergraduate Mathematics Education Study Program at the Universitas PGRI Semarang. The subject matter of this course contained the material of Junior High Senior Math and the introduction about how to teach it.

At the Design Stage, a mathematical learning media was produced in the form of learning videos on the topics like Surface Area of Cuboid, Cube, Prism and Pyramid which consisted of several parts. These parts were front page, apperception page, material page, sample problem page, and closing page. Products that were created during the design stage were then reviewed by media experts and material experts (Expert Judgment). This was done to get an assessment of whether this media was feasible or more is to be tested on the field both in terms of appearance and material.

The following is a table of gains from material expert validation.

Table-1. Expert of material validation.

No	Aspects of assessment	Expected score	Experts			Presentation (%)			Average presentation (%)
			1	2	3	1	2	3	
1	Media	20	18	16	19	90.00	80.00	95.00	83.33
2	Material substance	45	41	39	42	91.11	86.67	93.33	90.37
3	Instructional design	70	63	64	66	90.00	91.43	94.29	91.90

Source: Table was obtained from the results of the study.

The results of the assessment by material experts, namely two lecturers and one teacher placed themselves in very good criteria because the statistics reveal that media aspects validated were given 88.33%, material substance aspects are 90.37%, and learning design aspects are 91.90% so that each aspect is declared feasible with repairs in the form of a sequence of material delivery (in Table 1).

Expert of material validation average persentation (%)

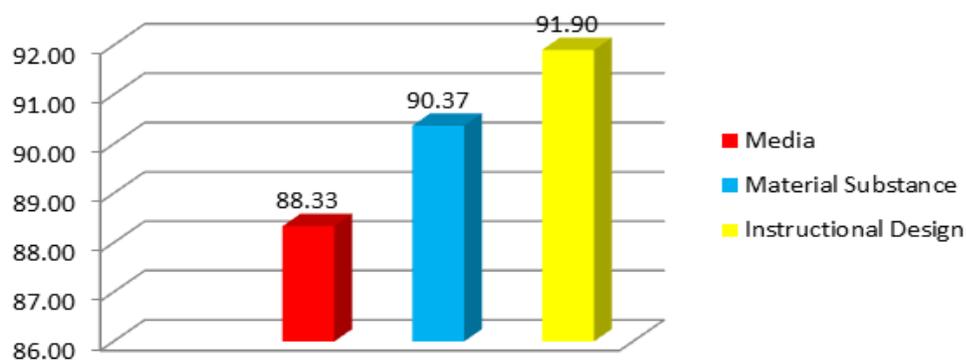


Figure-1. Bar chart from the results of the material expert validation.

The following is Table 2 exhibiting gains from media expert validation.

Table-2. Expert of media validation.

No	Aspects of assessment	Expected score	Experts			Presentation (%)			Average presentation (%)
			1	2	3	1	2	3	
1	Media	20	18	16	19	90.00	80.00	95.00	83.33
2	Learning presentation	40	41	39	42	91.11	86.67	93.33	90.37
3	Language feasibility	25	63	64	66	90.00	91.43	94.29	91.90
4	Graphics feasibility	25	23	24	25	92.00	96.00	100.00	96.00

Source: Table was obtained from the results of the study.

The results in Table 2 illustrate the assessment of media experts, namely two lecturers and one teacher placed themselves in very good criteria because the statistics reveal that the media aspect validated were given 91.67%, learning presentation aspects 95.00%, language feasibility aspects 97.33%, and feasibility aspects 98.00% so that each aspect is declared worthy of being applied in learning.

Expert of media validation average presentation (%)

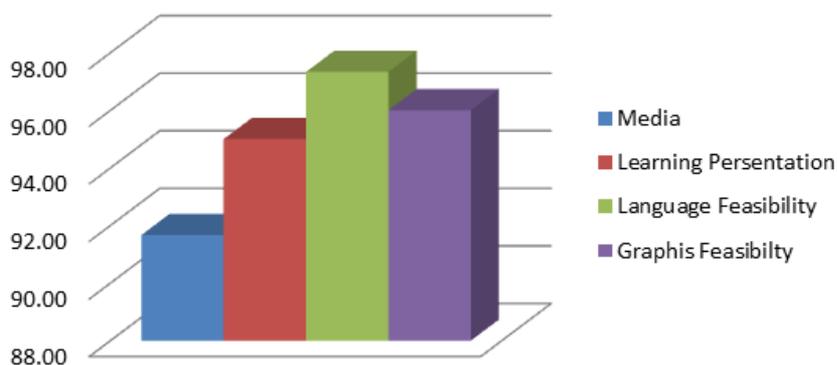


Figure-2. Bar chart from the results of the material expert validation.

Based on the first 3 steps of ADDIE model, product advantages and expert validation results reveal that a learning video on the material about surface area of cuboid, cube, prism and pyramid is suitable for the use of learning. The results of this development study are consistent with the results of previous studies, namely (Wahyana, 2018) on the development of learning videos using proshow on measured units and weight used as appropriate and instructional video teaching materials based on field test response questionnaires conducted on 12 students categorized very interesting so learning video teaching materials are very petrifying for students in the learning process and worthy of use and students are very interested in learning video teaching materials. Research (Effendi, 2016) on the development of tutorial video-based learning media on soil mechanics courses, showed the results of expert validation in the feasible category with the results of limited trials obtained in the percentage of 86.13% with a very feasible category.

Similarly, Rahmaibu (2016) examined the learning of Citizenship Education (Civics) subjects using Adobe Flash media to achieve very decent results from the assessment of material experts, whereas according to media experts, the learning media developed were feasible. Another research conducted by Letwinsky (2017) revealed a significant relationship between teachers' attitudes toward using technology for communication and personal self-efficacy, yet few reported using technology in this way. An important recommendation from Letwinsky (2017) study was to investigate why teachers who demonstrate key positive indicators for technology integration do not

capitalize on the potential that communication technology provides to cultivate mathematics communication and literacy. Krammer (2006) has also examined the effectiveness of learning with classroom video.

The evaluation aimed to obtain information about processes within the training, about the acceptance of the training by the teachers and about changes of the professional knowledge and the patterns of perception of teaching processes of the teachers. Aslan (2015) in his research on the perception of integrated information technology according to prospective teachers in universities in Turkey, recommended the use of technology that lectures use this technology, not only how to use technology, but also how technology can be used to teach and learn to be focused. Finally, Krammer (2006) within the framework of a yearlong teacher education program examined the conditions and effectiveness of learning with classroom videos. In online phases and face-to-face sessions (blended learning), 20 teachers from two different countries (Germany and Switzerland) analyzed videos of their own math lessons and math-lessons of other teachers. Using different instruments, the training program was evaluated from a scientific perspective.

5. CONCLUSION

Based on the results of the validation of media experts and material experts in their development using the ADDIE model which consisted of five phases, namely Analysis, Design, Development, Implementation and Evaluation showed the learning video on topics like Surface Area of Cuboid, Cube, Prism and Pyramid was a suitable learning media as teaching material by looking at the assessment of media experts at 95.15%, and material experts at 90.86%.

Based on the results of the research obtained, it is strongly recommended to improve the process of developing learning videos. Learning videos on the material of surface area of cuboid, cube, prism and pyramid are one of the learning media that can be used in learning activities, so the lecturer needs to develop it in making learning media on other topics so that the interests and creativity of lecturers and students can develop consistently.

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REFERENCES

- Aslan, A., 2015. Pre-service teachers' perceptions of ICT integration in teacher education in Turkey. *The Turkish Online of Educational Technology*, 14(3): 97-110.
- Bozkus, F., 2018. Middle school mathematics teacher's knowledge of mathematical reasoning. *European Journal of Education Studies*, 4(9): 16-33. Available at: [10.5281/zenodo.1287947](https://doi.org/10.5281/zenodo.1287947).
- Cruse, E., 2017. Using educational video in the classroom: Theory, research and practice. Available from <https://www.media-and-learning.eu/resource/using-educational-video-in-the-classroom-theory-research-and-practice>.
- Duron, R., 2006. Critical thinking framework for any discipline. *International Journal of Teaching and Learning in Higher Education*, 17(2): 160-166.
- Effendi, A., 2016. Development of learning media based on video tutorials on soil mechanics subjects. *Indonesian Journal of Civil Engineering Education*, 2(1): 1-9. Available at: <https://doi.org/10.20961/ijcee.v3i3.11198>.
- Krammer, K., 2006. Learning with classroom videos: Conception and first results of an online teacher-training program. *ZDM Mathematics Education*, 38(5): 422-443.
- Kurucova, 2018. The effect of different online education modes on the English language learning of media studies students. *Cogent Education Journal*, 5(1): 1-13.
- Letwinsky, K.M., 2017. Examining the relationship between secondary mathematics teachers' self-efficacy, attitudes, and use of technology to support communication and mathematics literacy. *International Journal of Research in Education and Science*, 3(1): 56-66.

- NCTM, 2000. Curriculum and evaluation standards for school Mathematics. Reston, VA: NCTM.
- Prasetyowati, D.K., 2013. Development of mathematics learning tools based on humanistic and constructivism using the SAVI (Somatic Auditory Visual Intellectual) approach assisted by an Interactive CD. AKSIOMA Journal, 5(1): 17-27.
- Rahmaibu, 2016. Development of learning media by using adobe flash to improve learning outcomes civics. UNNES Creative Journal, 7(1): 1-10.
- Rasiman, 2016. Development of junior high school mathematics learning videos based on curriculum K-13. Educational Research Media, 10(2): 2.
- Sadiman, 2008. Educational media: Definition, development and utilization. (Educational Media: Definition, Development and Utilization). Jakarta: Raja GrafindoPustaka.
- Suherman, E., 2001. Contemporary Mathematics learning. Bandung: JICA.
- Sumarno, U.M., 2015. Improving Mathematical reasoning ability and learning independence of Middle school students through problem based learning. (Improving Mathematical Reasoning Capabilities and Learning Independence of Junior High School Students through Problem Based Learning). STKIP Siliwangi e-Journal, 2(1): 40-51.
- Wahyana, R., 2018. Development of learning videos using proshow on material unit for measurement and weight. Proceedings of the National Seminar on Mathematics and Mathematics Education of UIN Raden Intan.

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