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Development of Interactive Learning Media Using Articulate Storyline 3 to Facilitate Students' Mathematical Problem-Solving Skills in Statistics SMA/MA

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A B S T R A C T

This research aims to develop an interactive learning media using Articulate Storyline 3 to facilitate students' mathematical problem-solving skills in statistics at the high school level. The development process utilized the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. The media was designed to guide students through the steps of problem-solving, including understanding the problem, planning the solution, executing the plan, and evaluating the solution. The developed media was validated by experts and found to be highly valid. A small-scale and large-scale trial was conducted to assess the media's effectiveness. Results from the small-scale trial showed that the media was highly practical for students with varying abilities. The large-scale trial also indicated that the media was practical and effective in facilitating students' mathematical problem-solving skills. In conclusion, the developed interactive learning media is a valuable tool to enhance students' mathematical problem-solving skills in statistics. It provides a structured and engaging learning experience is proven to be valid and practical that can help students develop critical thinking and problem-solving abilities.

1. Introduction

Mathematics is one of the disciplines that plays a significant role across various fields of study. The existence of mathematical knowledge enables individuals to think critically and innovatively, develop diverse skills, become competitive, and possess the capacity for lifelong learning (In'am, 2015). One of the objectives of mathematics education at the senior high school level, as stated in Regulation of the Minister of Education and Culture Number 21 of 2016, is to foster logical, critical, analytical, creative, accurate, responsible, and responsive attitudes, as well as perseverance in solving problems.

Problem-solving ability is one of the objectives of mathematics learning at both elementary and secondary education levels (Isro'il & Supriyanto, 2020). Mathematical problem-solving skills (KPMM) are essential for students to support the process of addressing mathematical challenges. Mathematical Problem-Solving Ability refers to the process of finding solutions to problems encountered in daily life (Yustinaningrum, 2021). According to Hasibuan et al. (2018), KPMM can sharpen reasoning skills to become more precise, logical, critical, and creative, and it allows students to be more analytical in making decisions in their lives. However, in reality, students' KPMM is still relatively low. This condition is evident from the large number of students who are still unable to solve non-routine, context-based mathematical problems.

Several research findings have indicated the low level of students' Mathematical Problem-Solving Ability (KPMM) in mathematics learning. A study conducted by Kushendri & Sylviana Zanthy (2021) found that the indicators of planning a solution and rechecking the solution received the lowest percentages among KPMM indicators, with scores of 60% and 31%, respectively. Another study by Suliani & Saputri (2021) also highlighted students' difficulties in solving problems related to measures of central tendency. Students struggled to calculate the average of grouped data due to their inability to identify the necessary information and a lack of accuracy in solving problems. In addition, research by Damayanti & Kartini (2022) revealed that although 75.3% of students were able to correctly identify the known and required information in a problem, only 15.70% of them were able to interpret the results of their calculations. These findings indicate that students' MPSA, particularly in statistical topics, remains at a low level.

The low level of Mathematical Problem-Solving Ability (KPMM) is also observed among students at SMA Negeri 10 Pekanbaru and SMA Negeri 2 Pekanbaru. Based on interviews conducted with teachers at these schools, it was found that students experienced difficulties in the process of solving mathematical problems, particularly in the topic of statistics. From observations of the learning resources used at SMA Negeri 10 Pekanbaru, the researcher found that the school does not yet have specific mathematics learning media to support the learning process, apart from PowerPoint presentations prepared by the teacher. In addition, the available learning resources do not incorporate the steps of mathematical problem-solving that can help facilitate the development of students' KPMM.

According to Rohmah & Sutiarso (as cited in Hasibuan et al., 2018), several factors contribute to the low Mathematical Problem-Solving Ability (KPMM) among students, including: (1) the inability to comprehend information effectively, (2) lack of experience in working diligently, (3) insufficient understanding of the subject matter, (4) weak mastery of prerequisite concepts, and (5) lack of accuracy in solving problems. Students require a more effective, integrated, and visually based learning approach to enhance their mathematical problem-solving abilities. According to Sari et al. (2022), learning processes that incorporate interactive learning media can help develop KPMM. This is also supported by Fariz et al. (2022), who stated that the development of interactive learning media can significantly improve students' KPMM. Based on these perspectives, utilizing

interactive learning media that provide opportunities for students to demonstrate problem-solving processes can contribute to the improvement of their KPMM.

Various software tools are available for developing learning media, one of which is Articulate Storyline 3, which can be utilized to create interactive instructional media. Articulate Storyline is easily accessible on both Android devices and PCs (Khusnah et al., 2020). Nugraheni (2017) also stated in her study that Articulate Storyline is highly suitable for developing interactive learning media, as it provides practical features for adding text, images, animations, and quizzes—allowing students to interact directly with and demonstrate their understanding of the material being studied. Articulate Storyline facilitates the development of interactive learning tools and enables users to design visually engaging media.

Based on the aforementioned explanation, the researcher considers it necessary to develop interactive learning media for statistics material in order to facilitate students' mathematical problem-solving abilities using the Articulate Storyline 3 application. Through the development of this interactive learning media, it is expected to support the mathematics learning process in facilitating students' problem-solving abilities in statistics by implementing a scientific approach. The interactive mathematics learning media developed with Articulate Storyline 3 can be used by students both during classroom instruction and independently outside the classroom. Therefore, the researcher deems it necessary to conduct a study aimed at developing interactive learning media assisted by Articulate Storyline 3 that meets the criteria of validity and practicality.

2. Methodology

The type of research conducted in this study is Research and Development (R&D). According to Borg and Gall (as cited in Sugiyono, 2015), research and development is a research method used to produce or develop a product whose feasibility has been tested. The development model employed in this study is the ADDIE model. The ADDIE model provides a systematic and sequential framework for organizing a series of development research activities (Rusdi, 2019). In this study, the product developed is an interactive learning media containing statistics material for twelfth-grade senior high school students. The development process involves several stages: 1) Analysis, the researcher analyzed learning needs, student characteristics, and curriculum requirements; 2) Design, the researcher gathered relevant materials, determined the sequence of content presentation, designed the media layout, created a media prototype, and prepared research instruments; 3) Development, the researcher conducted media validation and a one-to-one trial with students; 4) Implementation, the validated learning media was implemented with students; 5) Evaluation, the researcher made improvements based on identified weaknesses in the media.

This study involved 41 students from Grade XII of SMAN 10 Pekanbaru. The research trials were conducted through several stages, including a one-to-one trial to assess the readability of the interactive learning media based on Articulate

Storyline 3, a small group trial to identify deficiencies in the media, and a large group trial to evaluate the practicality of the revised student worksheet (LKPD). Data collection techniques included face-to-face interviews with mathematics teachers to identify fundamental problems, classroom observations of mathematics learning activities, and validation questionnaires to obtain expert assessments regarding the validity of the interactive learning media. The validation questionnaires and student response sheets were developed using a Likert Scale format with four response options: strongly inappropriate, inappropriate, appropriate, and strongly appropriate. The learning media is considered suitable for use if the average assessment score given by the validators falls within the "valid" or "highly valid" category.

Table 1. Criteria for Validity and Practicality of the Learning Media

Interval	Validity Category	Practicality Category
$85{,}01\% \leq V/P < 100{,}01\%$	Very Valid	Very Practical
$70{,}01\% \leq V/P < 85{,}01\%$	Valid	Practical
$50{,}01\% \leq V/P < 70{,}01\%$	Less Valid	Less Practical
$00{,}00\% \leq V/P < 50{,}01\%$	Not Valid	Not Practical

References: Akbar (2017)

The learning media can be tested on a large scale, or in a large group setting, if it is deemed practical or highly practical. If the learning media is found to be less practical or impractical, it must be revised accordingly.

3. Result and Discussion

The result of this research is a product in the form of interactive learning media assisted by Articulate Storyline 3, designed to facilitate students' mathematical problem-solving abilities in the topic of statistics for senior high school (SMA/MA) level. The development model employed in this study is the ADDIE model.

In the analysis stage, it was clearly identified that students require effective learning media to enhance their mathematical problem-solving skills, particularly in the topic of statistics. The results of interviews with mathematics teachers also revealed that students face difficulties in applying concepts, tend to be careless, and struggle to identify relevant information. A literature review on existing products indicated that there is currently no interactive mathematics learning media specifically designed to support mathematical problem-solving abilities in the context of statistics.

An analysis of the characteristics of the learners showed that most students possess good digital technology skills but still struggle to comprehend abstract mathematical concepts. Therefore, in designing the learning media, it is essential to begin the learning process with concrete and contextual examples. Furthermore, considering individual differences in students' abilities, the developed media must accommodate a range of student competency levels.

Based on the curriculum analysis, this research developed interactive learning media using Articulate Storyline 3 for the statistics topic in Grade XII of senior high school (SMA/MA), aligned with the 2013 Curriculum. The focus is on competencies related to determining and analyzing measures of central tendency and data dispersion, as well as solving problems related to frequency distribution tables and histograms.

The design stage of this study focused on the development of interactive learning media based on Articulate Storyline 3, aimed at enhancing students' problem-solving abilities in the topic of statistics. The main activities in this stage included collecting relevant materials from the curriculum, determining a logical and effective sequence for content presentation, designing an engaging and user-friendly layout for the learning media, creating a product prototype, and designing assessment instruments.

Following the design stage, the researcher developed the media based on the initial design. The validation process was conducted comprehensively, with particular emphasis on improving the layout of the media. The validation results indicated an average score of 95.85%, which falls under the "highly valid" category. This indicates that the learning media is suitable to be tested on students. Once the product met the validity criteria, revisions were made to the learning media, and a readability test was conducted to assess the clarity and comprehensibility of the developed interactive learning media. The readability test involved three students as subjects. Subsequent revisions were made based on the feedback provided by these students. The following are the validation results of the learning media from the three validators.

Table 2. Result of Validity of the Learning Media

Assessed Aspects	Average the Learning Media by Validators - (%)					Average (%)	Category
	1	2	3	4	5		
Face	96,11	95,28	96,67	94,44	95,83	95,66	Very Valid
Content	94,79	94,27	92,71	93,22	95,31	94,06	Very Valid
Construction	100	96,67	96,67	97,5	98,33	97,83	Very Valid
Average (%)	96,97	95,40	93,35	95,05	96,49	95,85	Very Valid

In the implementation stage, the trial was conducted at SMAN 10 Pekanbaru. This study included both a small group trial and a large group trial. The results of the student response questionnaire from the small group trial are presented in Table 3 below.

Table 3. Result of Small Group Trial

Assessed Aspects	Subtopic - (%)					Average (%)	Category
	1	2	3	4	5		
Content & Objectives	88,50	82,29	89,58	88,54	89,58	87,69	Very Practice
Learning Process	87,50	85,42	84,38	84,38	82,29	84,79	Practice
Technical Quality	82,81	81,25	83,33	88,02	85,94	84,27	Practice
Average (%)	86,27	82,98	85,76	86,98	85,94	85,59	Very Practice

The small group trial of the learning media was conducted with six students of varying ability levels. The average percentage of practicality in the small group trial was 85.59%, which falls into the category of highly practical. Improvements based on this trial included the creation of a supporting worksheet for practice question answers and revisions to the wording of instructional prompts on the exercise pages. The learning media, after being tested in the small group and deemed highly practical, was revised according to student suggestions and subsequently tested in a large group trial. The results of the student response questionnaire from the large group trial are presented in Table 4 below.

Table 4. Result of Large Group Trial

Assessed Aspects	Subtopic - (%)					Average (%)	Category
	1	2	3	4	5		
Content & Objectives	82,93	83,23	84,45	86,89	85,82	84,66	Practice
Learning Process	83,38	84,15	86,28	84,30	84,76	84,57	Practice
Technical Quality	84,30	83,69	85,06	85,44	85,06	84,71	Practice
Average (%)	83,54	83,69	85,26	85,54	85,21	84,65	Practice

In the large group trial, the learning media was tested on 41 students with heterogeneous ability levels. The trial aimed to determine the practicality of the developed learning media on both small and large scales. The assessed aspects included content and objectives, learning process, and technical quality. The average practicality score of the learning media in the large group trial was 84.65%, which falls under the practical category according to Akbar (2017).

The average score for the content and objectives aspect was 84.66%, categorized as practical. For the learning process aspect, the average score was 84.57%, also categorized as practical. These results indicate that the learning media is beneficial for students and effectively facilitates their mathematical problem-solving abilities through the learning experiences provided in the media. Students reported that the media developed by the researcher helped them understand the material better and assisted them in solving problems using structured problem-solving steps. The average score for the technical quality aspect was 84.71%, which also falls into the practical category.

The development of interactive learning media on statistics material assisted by Articulate Storyline 3 has met the criteria for validity and practicality, and therefore can be used as a reference or implemented by teachers in the teaching and learning process. However, since this study only covered the aspects of validity and practicality, it does not provide a complete picture of the effectiveness of the developed learning media. Thus, further research is recommended to measure its effectiveness.

4. Conclusion

This development research has produced a product in the form of interactive learning media assisted by Articulate Storyline 3 for statistics material at the senior

high school (SMA/MA) level, which is capable of facilitating students' mathematical problem-solving skills. The learning media fulfilled the criteria of being highly valid and practical following a validation process by three experts, a small group trial involving six students, and a large group trial involving 41 students.

This study successfully developed interactive learning media based on Articulate Storyline 3 for statistics material that is effective and relevant. The media can serve as a reference for teachers in enhancing the quality of mathematics instruction. Furthermore, the potential for future development of this media is considerable—not only for other mathematics topics but also for different educational levels. The flexibility of this media has also been proven to align well with both the 2013 Curriculum and the Merdeka Curriculum, making it adaptable to future curriculum developments.

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