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ABSTRACT

Mathematical problem-solving ability is one of the important competencies that students need to have in mathematics learning because it plays a role in helping students understand, plan, and solve various mathematical problems and problems in everyday life. Along with the development of digital technology, evaluation media are needed that are able to measure these abilities effectively, interestingly, and in accordance with the characteristics of 21st-century learning, one of which is through the use of the Quizizz platform combined with Minimum Competency Assessment (AKM) questions. This study aims to develop and determine the level of validity of Quizizz-based mathematics learning evaluation media and AKM-based pre-test and post-test instruments on the Three-Variable Linear Equation System (SPLTV) material to measure students' mathematical problem-solving abilities. The results of media validation by lecturers of the Mathematics Education Study Program showed that the developed media obtained a feasibility level of 82% with a very valid category. The results of the validation of the pre-test and post-test instruments showed a feasibility level of 96.67% with a very valid category. Thus, the Quizizz-based evaluation media and the pre-test and post-test instruments developed are declared very valid and suitable for use as an initial design for mathematics learning evaluation media and can be further developed at the Development, Implementation, and Evaluation stages.

Keywords : Quizizz, AKM , Mathematical Problem Solving Ability , Evaluation Media , SPLTV .

1. Introduction

Education is a crucial aspect in improving the quality of human resources capable of facing the various challenges and changes of the 21st century. Through education, students not only acquire knowledge but also develop the skills, character, creativity, and critical thinking abilities needed in social life. This is in line with Law of the Republic of Indonesia Number 20 of 2003 concerning the National Education System, which states that national education functions to develop capabilities and shape the character and civilization of a dignified nation in order to educate the nation's life. Furthermore, education also aims to develop the potential of students to become people who are faithful, have noble character, are knowledgeable, capable, creative, independent, democratic, and responsible. Therefore, education plays a strategic role in producing quality and competitive human resources in the global era.

Along with the increasingly rapid development of science and technology, the world of education is required to be able to adapt to various innovations that support improving the quality of learning. The use of technology in education is one effort to create an effective, efficient, and relevant learning process to meet the needs of the 21st century. Law of the Republic of Indonesia Number 11 of 2019 concerning the National System of Science and Technology emphasizes that the development of science and technology aims to improve the quality of education, research, development, and application of technology to support improving the quality of life of the community and the nation's competitiveness. Thus, the integration of technology in the educational process is a crucial step in preparing students who are able to adapt to current developments and have the competencies needed in the future.

Mathematics is a subject that plays a crucial role in developing students' logical, critical, systematic, and creative thinking skills. One of the primary goals of mathematics learning is to develop mathematical problem-solving skills, as these skills enable students to apply mathematical concepts to solve various problems encountered both in learning and in everyday life. According to (Al Ghifari et al., 2022), mathematical problem-solving skills are students' ability to correctly solve mathematical problems using appropriate strategies based on the problem-solving stages. Similarly, (Nu et al., 2023) state that problem-solving skills are a primary focus in mathematics learning because they focus not only on the final result but also on the process of finding the right solution. Therefore, mathematical problem-solving skills need to be optimally developed so that students are able to face the various learning challenges of the 21st century.

Although mathematical problem-solving skills are an important competency for students, various studies have shown that these skills have not yet developed optimally. Research conducted by (Rochadi & Yudhanegara, 2023) shows that high school students' mathematical problem-solving skills in solving story problems are in the moderate category, with some students still experiencing difficulties in understanding the problem, developing a solution strategy, and re-checking the answers obtained. The results of this study are supported by (Al Ghifari et al., 2022) who revealed that students' mathematical problem-solving skills still need to be improved because they are closely related to students' success in solving various mathematical problems. More specifically, in the material of the System of Linear Equations in Three Variables (SPLTV), (Sembiring & Sutirna, 2023) found that students' mathematical problem-solving skills are still in the moderate category, where most students experience difficulties in translating story problems into mathematical models and determining appropriate solution strategies. These findings indicate that efforts are needed to help teachers evaluate students' mathematical problem-solving abilities more effectively so that the difficulties experienced by students can be identified properly.

The development of digital technology provides opportunities for teachers to conduct more effective and engaging learning evaluations. One platform widely used in evaluation activities is Quizizz, a game-based assessment application that allows students to work on problems interactively through digital devices. According to (Inayaturohmah & Saraswati, 2022), the use of Quizizz as an evaluation medium in mathematics learning has proven effective in terms of student learning outcomes. Furthermore, (Pratama, 2023) stated that Quizizz can be used as a formal evaluation medium, such as daily assessments and exams, because it can help improve student concentration and engagement during the evaluation process. With its various features, Quizizz has the potential to become an alternative evaluation medium that suits the characteristics of 21st-century learning.

The superiority of Quizizz in evaluation activities is also supported by various development research results. (Jahring et al., 2022) developed a Quizizz-based mathematics learning evaluation instrument and found that the product met the criteria of being highly valid, highly practical, and effective for use in learning. Furthermore, (Husna et al., 2023) found that the use of Quizizz as an evaluation medium had a positive impact on students' mathematics learning outcomes. However, most previous research has focused on the effectiveness of using Quizizz or developing evaluation instruments in general, while the development of Quizizz-based evaluation media specifically containing Minimum Competency Assessment (AKM) questions to measure students' mathematical problem-solving abilities in the Three-Variable Linear Equation System (SPLTV) material is still limited. Therefore, further research is needed to develop evaluation media that meets these needs.

Learning media is a crucial component that can help convey information from teachers to students more effectively. The use of media in learning can help visualize abstract concepts, increase student attention, and create a more meaningful learning experience. According to (Maharani & Hidayah Putri, 2023), mathematics learning media acts as a tool that can facilitate students in understanding mathematical concepts more easily and interestingly. In line with this, (Hilyana et al., 2023) stated that the use of appropriate learning media can help overcome student learning difficulties and increase student engagement during the learning process. Therefore, the use of learning media is one effort that can be made to support the optimal achievement of mathematics learning goals.

Rapid technological developments require continuous development of learning media to meet the characteristics and needs of students in the digital age. Learning media development aims to produce valid, practical, and effective products for use in the learning and evaluation process. According to Rosyadi et al. (2023), learning media development is necessary to create a more interactive learning experience and increase student engagement. Furthermore, Putri Mardian et al. (2023) state that developing technology-based media can be a solution for delivering more engaging and modern learning. Therefore, media development should not only focus on appearance but also on its usefulness in helping students achieve desired competencies.

Various studies have shown that developing mathematics learning media can have a positive impact on student learning processes and outcomes. (Anam et al., 2022) developed mathematical literacy-based learning media and found that the developed media met valid criteria and was effective for use in mathematics learning. Furthermore, (Nisa & Mawardah, 2023) reported that developing educational game-based mathematics learning media produced valid, practical, and effective media, thereby increasing student engagement in learning. Another study conducted by (Mu'tiah et al., 2023) showed that mathematics learning media specifically developed to facilitate mathematical problem-solving skills achieved high levels of validity and practicality. These findings indicate that developing learning media is a relevant step to support improving the quality of mathematics learning and evaluation.

Before evaluation media is used in learning, a validation process is required to ensure that the developed media meets the appropriate aspects of content, appearance, language, and functionality. Validation is also necessary to ensure that the supporting modules and instruments used are able to accurately measure the intended competencies. (Marisa et al., 2023) stated that the validation process in development research plays a crucial role in obtaining a product that is suitable for use and serves as a basis for product revision and improvement. In line with this, (Fadjeri et al., 2022) stated that expert validation is necessary to ensure the developed media is of good quality and aligns with learning objectives. Therefore, the development of Quizizz-based evaluation media with AKM questions on SPLTV material requires media validation, module validation, and test instrument validation to ensure the resulting product has a level of feasibility that can be accounted for.

Based on the description, this study was conducted to develop a Quizizz-based mathematics learning evaluation media with AKM questions on the Three-Variable Linear Equation System (SPLTV) material to measure students' mathematical problem-solving abilities. The focus of this study was to determine the level of validity of the developed evaluation media, the level of validity of the supporting modules used in the media implementation, and the level of validity of the pre-test and post-test instruments used to measure students' mathematical problem-solving abilities. The results of this study are expected to produce valid and suitable evaluation media for use as an alternative evaluation of technology-based mathematics learning at the high school level.

2. Methods

This research is a research and development (R&D) that aims to develop a Quizizz-based mathematics learning evaluation media with Minimum Competency Assessment (AKM) questions to measure students' mathematical problem-solving abilities on the Three-Variable Linear Equation System (SPLTV) material. The development model used is ADDIE which consists of five stages, namely Analysis, Design, Development, Implementation, and Evaluation. However, considering the limited research time, the implementation of this research is limited to only the Analysis and Design stages.

The analysis phase was conducted to identify the need for developing evaluation media that aligns with the characteristics of mathematics learning. The analysis was conducted through a literature review of various studies related to students' mathematical problem-solving abilities, the use of technology-based evaluation media, and the application of AKM questions in mathematics learning. Furthermore, an analysis of the SPLTV material and the indicators of mathematical problem-solving abilities to be measured was conducted. The analysis results indicate that mathematical problem-solving abilities are an important competency that still needs improvement, thus requiring evaluation media that can measure these abilities effectively and engagingly for students.

The design phase involved designing Quizizz-based evaluation media and its supporting tools. Activities at this stage included developing a question grid based on mathematical problem-solving ability indicators, developing AKM questions for the SPLTV material, designing the media usage flow, and creating an initial design for the evaluation media using the Quizizz platform. In addition to the evaluation media, this phase also developed a media usage module and pre-test and post-test instruments to measure students' mathematical problem-solving abilities.

To obtain a product that is suitable for use, the media design, module, and test instrument were validated by validators who are lecturers in the Mathematics Education Study Program. Validation was conducted using a validation sheet containing aspects of content, construction, language, and presentation. Validation data were analyzed descriptively to determine the level of validity of the developed media, module, and instrument. The validation results were used as a basis for making improvements and refinements to the product design before entering the development stage in further research.

3. Results and Discussion

Analysis Stage Results

The analysis phase was conducted to identify the need for developing evaluation media that aligns with the research objectives. Based on the results of the literature review, mathematical problem-solving skills were chosen as the focus of the research because they are one of the essential competencies that students must possess in mathematics learning. These skills are not only related to conceptual mastery, but also to students' abilities to understand problems, plan solution strategies, implement solutions, and review the results obtained. Various studies have shown that students' mathematical problem-solving skills still need to be improved, so an evaluation instrument that can measure these skills more effectively is needed. Therefore, the development of evaluation media in this study focused on measuring students' mathematical problem-solving skills.

In addition to the needs analysis, an analysis of the materials and media to be used was also conducted. The System of Linear Equations in Three Variables (SPLTV) material was chosen because it has contextual problem characteristics that allow students to apply various stages of mathematical problem solving. This material is also suitable for development in the

form of questions based on the Minimum Competency Assessment (AKM), which emphasizes reasoning and problem-solving skills in the context of everyday life. Based on the results of the media analysis, Quizizz was chosen as the evaluation platform because it is able to present questions interactively, provide direct feedback, and facilitate teachers in managing student evaluation results. The results of this analysis became the basis for designing evaluation media, pre-test and post-test instruments, and media usage modules during the design stage.

Pre-Test and Post-Test Instrument Design

The pre-test and post-test instruments were designed to measure students' mathematical problem-solving abilities in the Three-Variable Linear Equation System (SPLTV) material. The instrument was developed based on mathematical problem-solving ability indicators, which include understanding the problem, planning the solution, implementing the solution, and reviewing the solution results. The instrument consisted of four AKM-based questions in descriptive form.

Table 1.

Grid of Pre-Test and Post-Test Questions

No	Material	Problem Solving Ability Indicator	Question Indicator	Cognitive Aspects	Question Format
1	SPL TV	Understand the problem, Plan, Implement, Evaluate	Student capable identify information that is known and asked in context purchase tool write , compile a mathematical model of SPLTV, determine price of each tool write , and analyze sufficient funds based on results calculation .	C 3	Description
2	SPL TV	Understand the problem, Plan, Implement, Evaluate	Student capable identify information on transactions sale tickets , forming SPLTV models, determining price of each type tickets , as well as evaluate is the money owned Enough For buy tickets required .	C4	Description
3	SPL TV	Understand the problem, Plan,	Student capable understand	C4	Description

		Implement, Evaluate	information purchasing bread, constructing a SPLTV model from available data , determining the price of each type of bread, and interpret results For take decision related buyer's financial sufficiency .		
4	SPL TV	Understand the problem, Plan, Implement, Evaluate	Student capable identify information about internet packages , compiling mathematical models of SPLTV, determining price every internet packages , as well as evaluate ability consumer in buy package based on available funds .	C4	Description

Pre-Test and Post-Test Instrument Validation Results

The pre-test and post-test instruments that had been designed were then validated by lecturers in the Mathematics Education Study Program. Validation was conducted to determine the instrument's level of feasibility in terms of material, construction, and language before being used as a measuring tool for students' mathematical problem-solving abilities. Assessment was conducted using a maximum score scale of 4, with the following criteria: 4 = very good, 3 = good, 2 = sufficient, and 1 = less.

Table 2.

Assessment Aspects

No	Assessment Indicators	Evaluation
Material Aspect		
1.	Questions in accordance with learning objectives	4
2.	Questions according to the measured indicators	4
3.	Questions are in accordance with the competencies that students must achieve	3
4.	The material asked is relevant to the learning material	4
5.	The level of difficulty of the questions is according to the student's ability	4

Construction Aspects

- | | |
|---|---|
| 6. The formulation of the question is clear and does not give rise to multiple interpretations. | 4 |
| 7. The questions are arranged systematically | 4 |
| 8. Easy to understand work instructions | 4 |
| 9. Images, tables or illustrations (if any) support understanding of the questions | 4 |
| 10. Questions are able to measure the targeted abilities | 3 |

Language Aspects

- | | |
|--|---|
| 11. The language used is appropriate to the student's development level. | 4 |
| 12. Sentences using good and correct Indonesian language rules | 4 |
| 13. The terms used are fixed and consistent. | 4 |
| 14. Sentences are easy for students to understand | 4 |
| 15. There are no spelling or punctuation errors | 4 |

Overall Rating

Total Score	58 (Fifty Eight)
Maximum Score	60 (Sixty)
Eligibility Percentage	96.67%
Eligibility Criteria	Very Valid
Validator Conclusion	Can be used with minor revisions
Validator Suggestions and Input	Try to vary the cognitive levels, for example there is C3

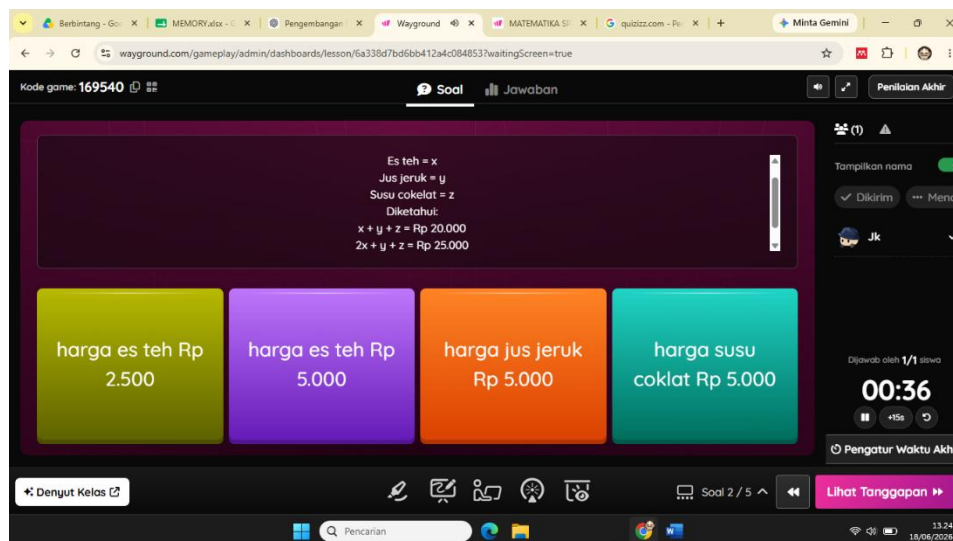
Based on the validation results, the pre-test and post-test instruments achieved an average percentage of 96.67%, categorized as highly valid. These results indicate that the developed instrument aligns with the indicators of mathematical problem-solving ability and the SPLTV material. However, the validator provided several suggestions for improvement. These suggestions were used as the basis for revising the instrument to obtain a better and more suitable instrument for use.

Quizizz Media Design

The evaluation media in this study was developed using the Quizizz platform, which is designed to measure students' mathematical problem-solving abilities in the Three-Variable Linear Equation System (SPLTV) material. Quizizz was selected based on its ability to present questions interactively, provide immediate feedback, and facilitate teachers in managing student evaluation results. This media contains questions based on the Minimum Competency Assessment (AKM) arranged according to indicators of mathematical problem-solving abilities.

Figure 1.

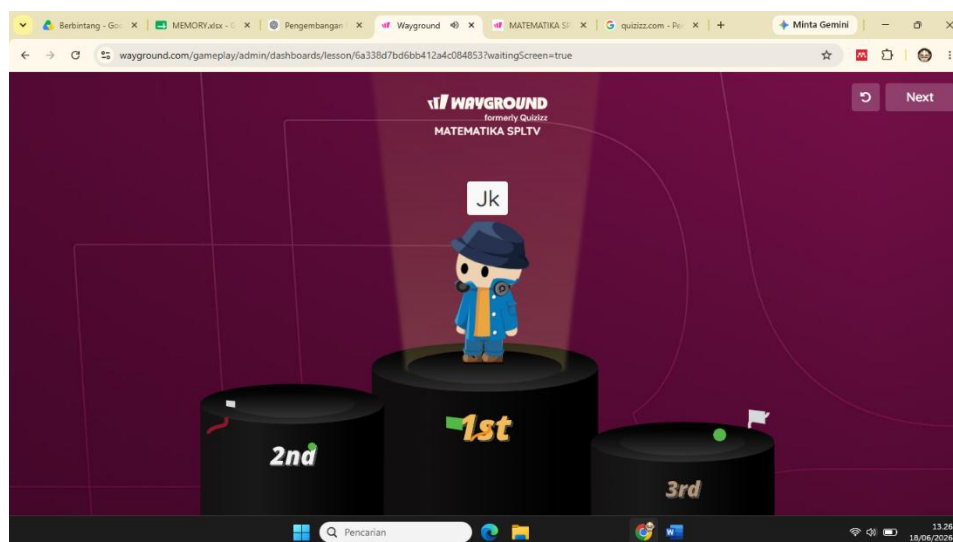
This is the initial screen after students log in to the Quizizz website and enter their name and game ID.



This screen contains questions that students must complete within a certain time frame. There are four answer choices, from which students must choose the correct one. If the answer is correct, students will receive points.

Figure 2.

This is the screen after all questions have been answered.



The rankings for the students with the highest scores are displayed, along with a performance graph for each student. This display motivates students to compete for top spot.

Quizizz Media Validation Results

The Quizizz-based evaluation media that had been designed was then validated by lecturers from the Mathematics Education Study Program to determine its suitability before

use. Validation was conducted on several aspects, including appearance, content, language, and ease of use. The validation results were used as a basis for revising and refining the developed media. Assessment was conducted using a Likert scale of 1-5.

Total Score	41 (Forty One)
Maximum Score	50 (Fifty)
Eligibility Percentage	82%
Eligibility Criteria	Very Valid
Validator Conclusion	Valid for use with revisions according to suggestions
Validator Suggestions and Input	The writing is not large enough, and try to use the same size

Table 4.
Media Assessment

No	Statement	Evaluation
1.	The appearance of the quizizz-based evaluation media is interesting and not boring.	Agree
2.	The layout of the evaluation media is arranged consistently and systematically.	Agree
3.	The type and size of letters used are easy to read	Agree
4.	The use of colors is appropriate and comfortable to look at.	Strongly agree
5.	The images, icons, or illustrations used support understanding of the questions.	Agree
6.	Navigation and features on Quizizz are easy for students to use.	Agree
7.	Instructions for using the evaluation media are presented clearly and are easy to understand.	Agree
8.	Evaluation media is easily accessible through the devices used by students.	Agree
9.	The media display design is consistent in every section	Agree
10.	Quizizz-based evaluation media is user friendly	Agree

4. Conclusion

Based on the research results, a design for a Quizizz-based mathematics learning evaluation media with Minimum Competency Assessment (AKM) questions on the Three-Variable Linear Equation System (SPLTV) material has been produced to measure students' mathematical problem-solving abilities. The media development was carried out using the ADDIE model which was limited to the Analysis and Design stages. At the analysis stage,

information was obtained that mathematical problem-solving ability is one of the important competencies that need to be developed and measured through evaluations that are in accordance with the characteristics of 21st-century learning. In addition, Quizizz was chosen as an evaluation platform because it is able to present questions interactively and provide direct feedback to users.

At the design stage, AKM-based pre-test and post-test instruments were produced, compiled based on indicators of mathematical problem-solving abilities, as well as a design for evaluation media using the Quizizz platform. Validation results by lecturers of the Mathematics Education Study Program showed that the instruments and media developed were categorized as very valid, making them suitable for use as initial designs for mathematics learning evaluation media. Thus, the Quizizz-based evaluation media designed in this study can be used as a basis for further development at the Development, Implementation, and Evaluation stages to test the practicality and effectiveness of their use in learning.

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