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Development of puzzle game learning media in social sciences subjects to improve student learning outcomes

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ABSTRACT

This research is aimed at (1) developing puzzle game learning media with material from the Asian Continent and Other Continents, (2) testing the feasibility of puzzle game learning media, and (3) testing the effectiveness of puzzle game learning media in improving student learning outcomes. The research uses the research and development (R&D) method with the ADDIE design. The research instrument is a questionnaire sheet and a multiple-choice question instrument. Data analysis was obtained from the pretest and posttest results, which were analyzed using the normality test, homogeneity test, and paired sample t-test. The results of this research and development are (1) the media developed is a puzzle game learning media, (2) the validity test shows that the puzzle game learning media has a "very suitable" category for further use in the social studies learning process, (3) effectiveness analysis, it can be concluded that the use of puzzle game learning media is efficacious in improving student learning outcomes in social studies subjects in one of the state schools in District X. Recommendations for further research and development include utilizing innovative AR (Augmented Reality) technology features, further developing elements of the quiz feature by adding several puzzle patterns at higher levels or more difficult levels.

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INTRODUCTION

Information and communication technology use marks the development of the 21st century. Information and communication technology, in its development, provides so much convenience quickly or in real-time (Baroya, 2018). Technology is used in education by creating innovative learning media that attracts students' interest. Updates to strategies and types of learning media must be carried out in learning activities, supported by technology that can create exciting and interactive learning conditions (Latifah et al., 2020). Subjects considered tedious and challenging to utilize various innovative, technology-based learning media include social studies (Ciputra et al., 2020). Social sciences is one of the scientific disciplines taught to elementary and middle school students. Learning about social studies covers various humanities and social sciences fields, as well as fundamental human behavior and analysis of historical events using generalizations about social phenomena (Ayssyah, 2019; Naisau et al., 2021). Students need an attractive, fun, interactive, inspiring, challenging, and motivating learning method (Fatmawati & Harmanto, 2019). With this, it

is necessary to provide variations in the learning process so that students can be interested in participating in learning.

Currently, there are still many teachers who use the lecture method in delivering material to students. The learning process of this lecture method could be more optimal because only a few students can memorize the material presented (Indriyanti et al., 2020). Based on the results of observations and interviews on Monday, April 26, 2021, at one of the junior high schools in Regency, It is known that students experience boredom because they do not have proper readiness in responding to learning material, the lack of level of student involvement in learning is also a problem for students in participating in learning. Apart from that, social studies subjects are known as rote lessons, and the material coverage needs to be narrower, making students bored with learning, coupled with the delivery of material by teachers, which seems monotonous and uninteresting. Teachers often use student books, worksheets, and PowerPoint during the learning process in class. Teacher-centered teaching methods that dominate learning can also cause students to become bored more quickly (Hardiyanti et al., 2020). In addition, because social studies is a subject with much information for everyday life, students are expected to be actively involved in their studies (Maslukhah & Abdullah, 2013).

The material on the Asian Continent and Other Continents has a broad scope of material, and there is much memorization, making students feel bored more quickly so that students pay less attention to the teacher's explanation of the material, resulting in less than optimal learning outcomes. Based on the results of the pretest, it was found that student learning outcomes were still below the specified minimum completeness criteria value. Snakes and Ladders learning media showed student learning outcomes and increased minimum completeness criteria scores by 45% (Syawaluddin et al., 2020). Students found it easier to gain understanding and motivate students to learn. It is necessary to develop creative and innovative learning media to support the learning process that refers to technological advances. Technological developments can make it easier to deliver teaching materials to students (Ciputra et al., 2020). Innovative learning media is beneficial in the learning process in the classroom; students are increasingly helped in understanding the material being taught, arouses students' learning motivation, triggers students' critical thinking power, and can create a conducive classroom atmosphere (Ciputra et al., 2020; Wulan et al., 2019). Game-based learning media is relatively underdeveloped for teaching and learning activities, even though it can encourage students to participate actively in learning (Hafidah et al., 2016; Husna et al., 2017).

Alternatives to using media in social studies learning are aimed at overcoming the shortcomings of learning media, namely puzzle media. The use of social studies media in one of the state junior high schools in District X needs to meet the needs of social studies teachers in developing game media. This is due to the need for more use of technology in learning activities and supporting infrastructure in schools. Social studies teachers tend to be limited in using the media provided by the school (Tunjung & Purnomo, 2020). However, examining puzzle media can train patience, hone thinking power, help students practice accuracy, and make memorizing more enjoyable (Khomsoh, 2013). Puzzle games can also increase students' desire to learn and make them more involved in learning in class because they directly participate in learning activities (Husna et al., 2017; Permata et al., 2017). Therefore, the development of social studies learning media based on puzzle game media needs to be developed to increase student's interest in social studies learning and the development of renewable technology. The development of this application-based puzzle game media provides much practicality for students and teachers because the puzzle media can be accessed in online and offline learning.

Researchers develop learning media that leads to sophisticated application-based technology with material on the Location and Area of the Asian Continent and Other Continents. This material is used because, in the material on the Location and Area of Asian Continent and Other Continents, students need accuracy and a good understanding of geography in analyzing and describing the Location and Area of the Asian Continent and Other Continents (Wahyuni, 2020). Puzzle games involve students directly in teaching and learning activities; therefore, the material can be conveyed well. Puzzle games in the form of pieces of images make it easier for teachers to get material and help students be more enthusiastic when participating in teaching and learning activities (Syafitri et

al., 2019). The media development is application-based and has various features, such as short videos, to support the material. Remember the learning material that is packaged attractively. There are also different practice questions in the puzzle game with added images of puzzle pieces that have been scrambled. Students must first arrange the pictures of the puzzle pieces provided. The random puzzle pieces set are the answers to existing questions.

Based on research conducted by Khomsoh & Gregorius (2013), the use of puzzle media in social studies learning increases teacher and student activity. Student learning outcomes also experienced an increase in the average score on formative tests. Students also show interest in the teaching provided. The weakness in this research is that the puzzle media was applied to fifth-grade elementary school students, so a similar application is needed at the junior high school level. Students' motivation to learn increased, the learning environment became more interesting and exciting, and it encouraged students to take an active role in teaching and learning activities thanks to the development of interactive whiteboard-based puzzle game media. The weakness of developing an interactive whiteboard-based puzzle game is that it can only be accessed using the interactive whiteboard in schools and cannot be accessed via smartphone. Meanwhile, other research by Ciputra et al. (2020) states that the puzzle map media, where the development utilizes Adobe Flash with the contextual teaching and learning method, is effectively applied in teaching and learning activities to improve student learning outcomes. However, this development only used the puzzle map media for fourth-grade elementary school students. This makes it necessary to develop similar media for junior high school students.

This research is vital because puzzle games are an effective teaching tool because they help students understand and discover lesson topics. Puzzle games also help students think critically and creatively when solving problems and help them fully engage in educational activities (Marfuah et al., 2014). Puzzle game learning media can also help change the learning method from previously using the teacher-centered method to student-centered. It is also a means of using innovative, technology-based learning media rather than previously using learning media such as textbooks or other conventional learning media. Based on this background, the objectives to be achieved are: (1) developing puzzle game learning media with material from the Asian continent and other continents, (2) testing the feasibility of puzzle game learning media in improving student learning outcomes, and (3) testing the effectiveness of learning media puzzle games in improving student learning outcomes. Development research contributes to increased interest and motivation in learning and helps improve learning outcomes.

METHOD

This research uses an R&D (Research and Development) approach with an ADDIE design (Branch, 2009). The researcher chose the ADDIE design because this research design is easy to understand, and the research activity procedures are structured systematically like Figure 1, which can help in solving learning problems related to learning media that are tailored to the needs and characteristics of students (Masturah et al., 2018; Ratnawati et al., 2021).

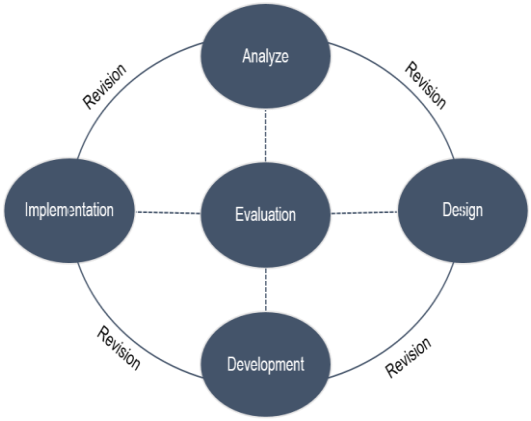

Figure 1. Research and Development Procedures

Qualitative and quantitative data were obtained directly from research subjects. The subjects of this research and development are class IX students at one of the State Middle Schools in District X. The research instrument used to collect research data was a questionnaire validation, student response questionnaires, and multiple choice test questions. The instruments used in this research and development are an open questionnaire in the form of qualitative data regarding criticism and suggestions given by validators and students and a closed questionnaire in the form of quantitative data regarding the assessment of products that have been developed (Febrianti et al., 2021). Research data analysis uses validity analysis and statistical analysis. Validity analysis uses the Formula 1:

$$P = \frac{\sum x}{\sum xi} \times 100\% \quad (1)$$

P is validity Percentage, $\sum x$ is the assessment score in one item, $\sum xi$ is the ideal assessment score in one item, and 100% is constant. After analyzing the data, further explanation is carried out, and conclusions are obtained by assessing Table 1 (Akbar, 2017).

Table 1. Product Validity Level Assessment Criteria

No.	Percentage	Criteria	Category
1	81 - 100%	Very Worth it	No Revision
2	61 - 80%	Worthy	Partial Revision
3	41 – 40%	Decent Enough	Revision (Retest)
4	21 – 40%	Not Worth it	Total revision (Retest)

Statistical analysis in testing normality, homogeneity, and paired sample t-test. Statistical analysis was done using pretest and posttest scores in the experimental and control classes. Before the paired sample t-test, normality, and homogeneity tests are carried out. The pretest and posttest results were analyzed using the paired sample t-test for hypothesis testing. The results of the paired sample t-test were then compared with a significance value of 0.05 (5%) to determine whether the puzzle game learning media was influential in use.

RESULTS AND DISCUSSION

Results

Analysis

The previous analysis was used as a guide and material for consideration when preparing puzzle game learning media. The analysis carried out includes complexity analysis and user needs analysis. Complexity analysis is used to determine and group the problems that schools face related to materials and types of learning media. Complexity analysis includes analysis of core and essential competencies and analysis of material concepts. Interviews with social studies teachers showed that textbooks or worksheets were used most often in delivering material using the lecture method (teacher-centered learning). The social studies teacher also said that the choice of media used in learning influences students' interest and motivation to learn. The interview results also prove that there is material that is difficult for students to conceptualize, namely in the chapter on interaction between Asian countries and other countries with the sub-chapter location and area of the Asian continent and different continents. Apart from that, students quickly get bored if the learning process is carried out only with the help of PowerPoints or textbooks. To increase enthusiasm for learning, students' motivation to learn and reduce boredom, and innovative learning media that can support the learning process are needed.

User needs analysis is carried out to determine the learning media students need to improve the quality of learning. The user-required analysis questionnaire was distributed online using Google Forms. Distribution using this Google form was chosen because it can speed up the distribution of questionnaires and has a broad reach. Questionnaires were distributed to students in class IX at one of the State Middle Schools in District X. Based on Figure 2 of the questionnaire results, as a follow-up to the analysis of student needs, it can be interpreted that if the teacher has utilized learning media, it is only in the form of student textbooks or worksheets. This shows the need to use other learning

media that are more innovative, increase learning motivation, increase students' interest in learning, and can improve learning outcomes when participating in class learning. Sutaryono & Santosa (2019) in his research, he explained that critical thinking skills and student learning outcomes had increased, driven by the use of creative and innovative media. Puzzle game learning media could be developed by adjusting the material students need. Previous research that supports this was conducted by Sutaryono & Santosa (2019) who developed a magic puzzle media based on visual auditory kinesthetic, based on problems found in class and then aligning it with the needs of teachers and students.

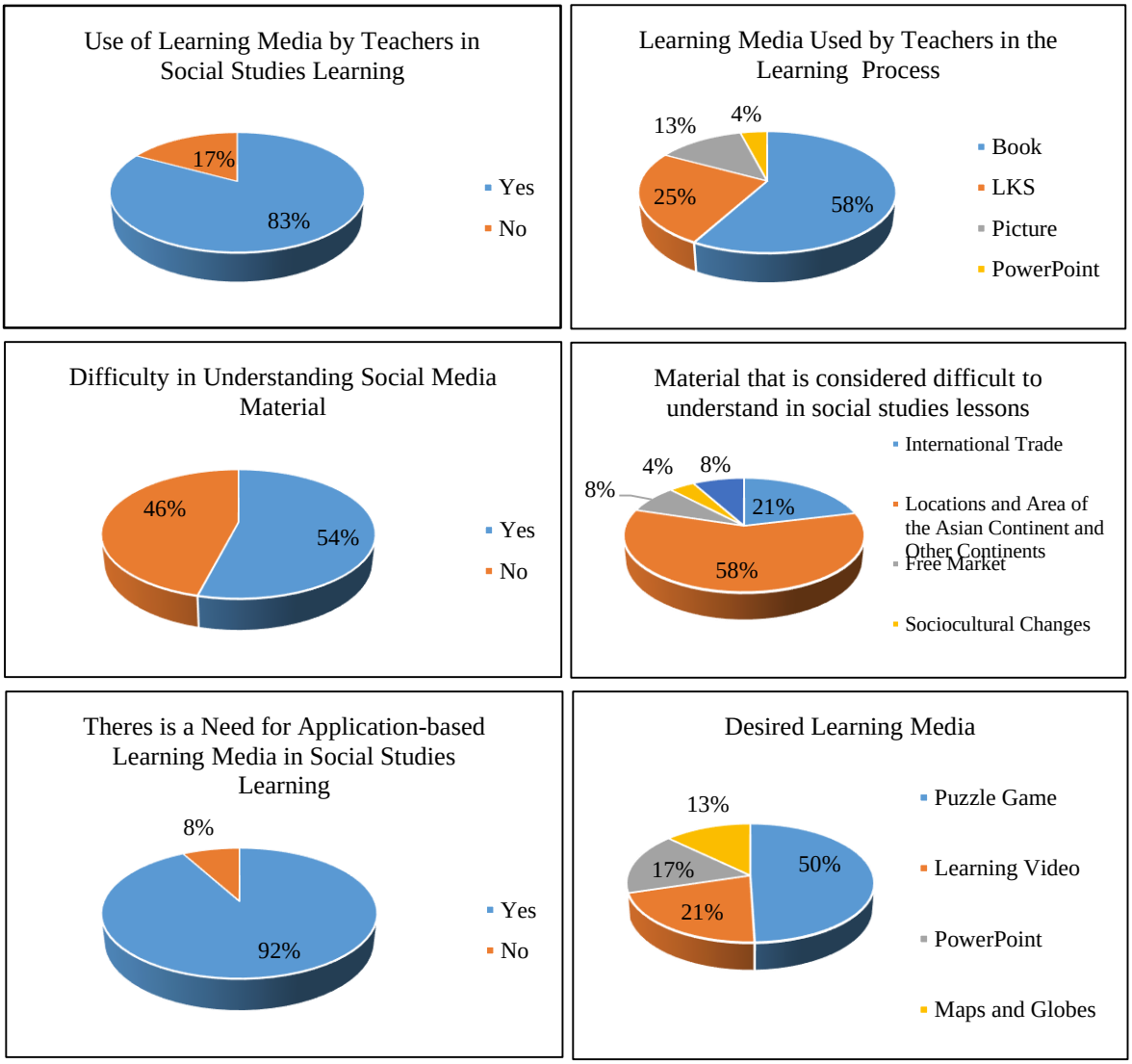

Figure 2. Results Analysis

Design

Puzzle game product design is designed according to students' usage needs at the analysis stage. Product design begins with media selection, which is done by selecting appropriate learning media to further develop into a learning media product that supports the learning process. Then, a storyboard is prepared, which functions as an initial description and design of the puzzle game learning media. Preparing storyboards also plays a role in designing the start page to the quiz page. I prepare material items by identifying core and essential competencies, determining the type of learning material used, and selecting learning resources for references. This learning media product is made as an application and stored in an extension file (exe) in landscape format.

Development

This development stage consists of product creation and feasibility testing of puzzle game learning media products developing puzzle game learning media products using Adobe Animate software. Developing puzzle game learning media products begins with learning objectives, preparing material according to the syllabus, developing puzzle game learning media according to the storyboard, and evaluating (including practice questions). The puzzle game learning media has several display menus, such as the initial display in Figure 3, the material page menu in Figures 4 and 5, and the quiz page in Figure 6. This development stage results in a puzzle game learning media product structured according to competencies and a questionnaire sheet to measure the validity of the media and user responses.

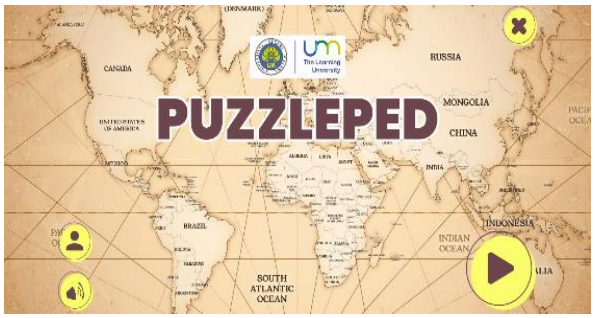

Figure 3. Initial View

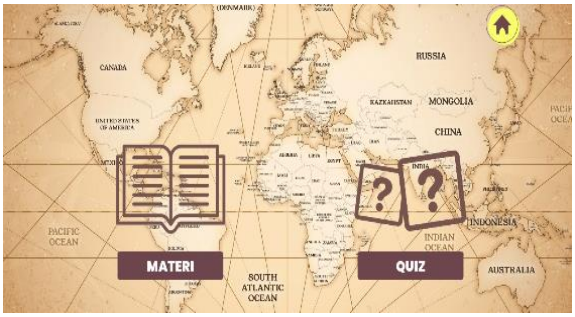

Figure 4. Initial Menu Display

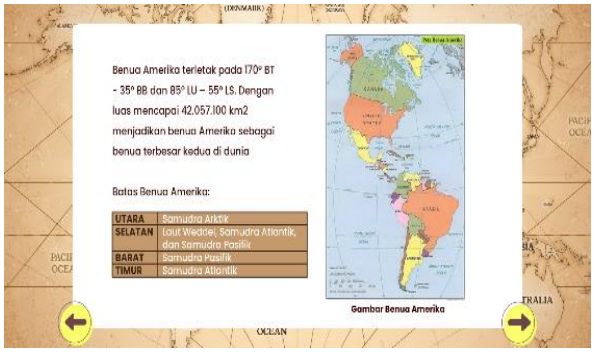

Figure 5. Material Menu Display

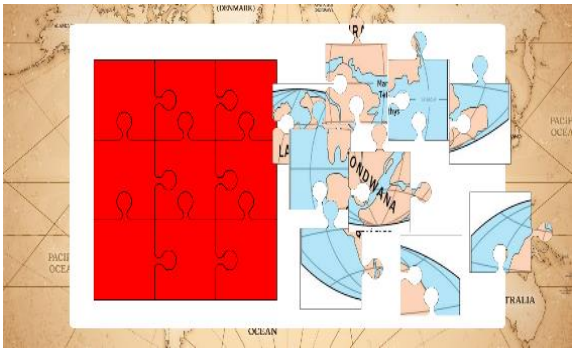

Figure 6. Quiz Menu Display

The material expert is Fatiya Rosyida, S. Pd., M. Pd., a Lecturer in the Department of Geography, Faculty of Social Sciences, State University of Malang. The validation test was carried out on June 30, 2022. Validate the material used for assessment by attaching a questionnaire sheet with suggestions and a comments/suggestions column.

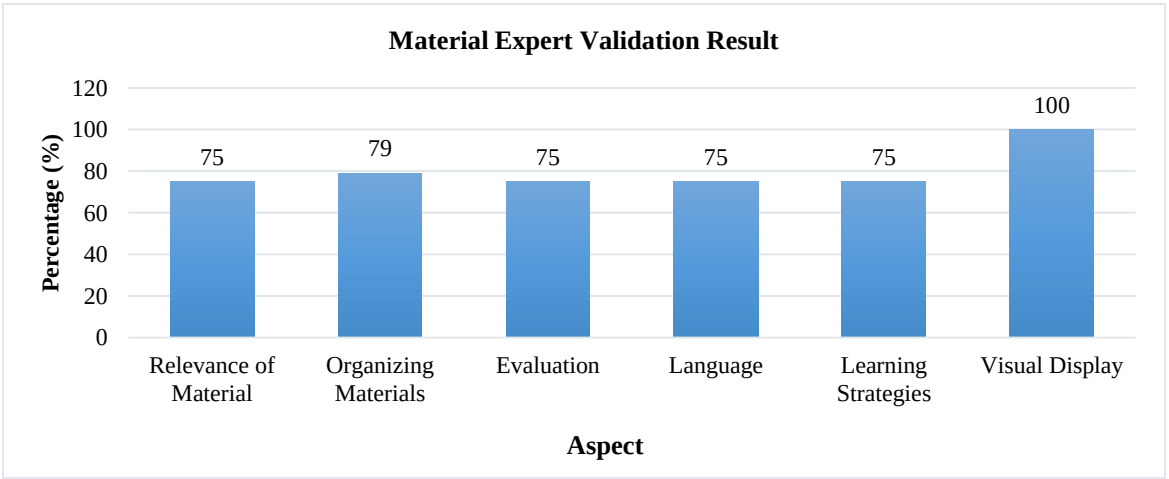

Figure 7. Material Expert Validation Results

Based on the data in Figure 7 above, the percentage of material aspects is 81%. This percentage shows that the material in the puzzle game learning media meets the eligibility criteria of being "very feasible." This indicates that the puzzle game learning media material has been arranged in detail, clearly, and by students' needs. So, exposure to puzzle game learning media material can help students understand the material better. As a means of delivering material in the classroom learning process, learning media is needed. Without utilizing learning media, the delivery of material will be abstract, and student's understanding of the material will also decrease because students cannot visualize the material being taught (Tunjung & Purnomo, 2020). These results show that the material can be used in puzzle game learning media products and is suitable for testing with educational practitioners and students. However, there are several improvements to improve the material before the trial.

Agung Wiradimadja, M.Pd, conducted the feasibility test by media experts as a Lecturer in the Social Sciences Education Study Program, Faculty of Social Sciences, State University of Malang. The media validation stage was carried out on June 28, 2022. Media validation uses an assessment by attaching a questionnaire sheet containing 20 statements and a comments/suggestions column. Assessment involves several things, including visual appearance, language, learning strategies, and software engineering.

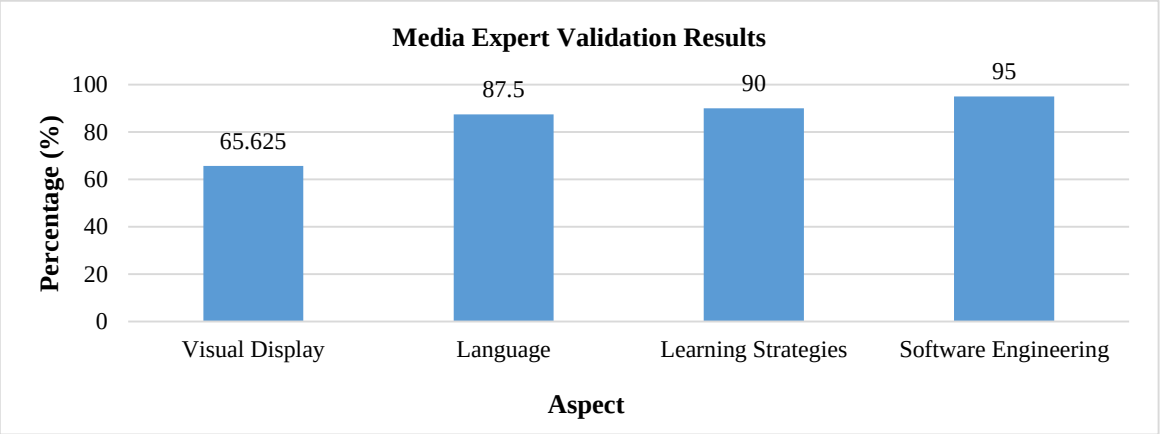

Figure 8. Media Expert Validation Results

The percentage of media suitability was obtained at 81%, as shown in Figure 8 above. The percentage shows that if you fall within the " very suitable eligibility criteria," qualifications can be tested for the product puzzle games. Puzzle game learning media provides learning experiences through visual symbols. So students can construct their understanding through pictures of continents and their appearance. According to Edgar Dale's cone theory of knowledge, learning activities using learning media using the five senses can be applied to the learning process (Nasrullah et al., 2021).

Classroom learning will be effective and can provide concrete experiences to students by using puzzle game learning media. Students can understand the material better through actual images, not just concepts or writing (Tunjung & Purnomo, 2020). The quiz menu is the puzzle game learning media feature that embodies this opinion. It can make students actively develop their senses so that they have skills and knowledge. Puzzle game discovering media places students as the subject of learning; students carry out learning activities independently based on the teacher's prepared activity plans. The teacher in the class only acts as a facilitator to accompany the students. Based on constructivism theory, a facilitator has the skills to help students learn to achieve learning goals (Djamaluddin & Wardana, 2019). Based on the media validation results, puzzle game learning media products can conduct trials with educational practitioners and respond to student use.

Implementation

Puzzle game learning media is applied to users after validation by expert validators, which is carried out at the development stage. The implementation phase involved teachers as educational practitioners and 32 students in class IX-A as the experimental class.

Trials by educational practitioners were carried out to determine the response of educational practitioners, namely Andrie Astutik, M.Pd, as a social studies subject teacher at one of the State Middle Schools in District X. The trial was carried out on June 28, 2022. The assessment of the trial stage was done by attaching a questionnaire sheet containing 20 component statements and a comments/suggestions column. Assessment consists of several things, such as language, puzzle game application components, material organization, and overall presentation.

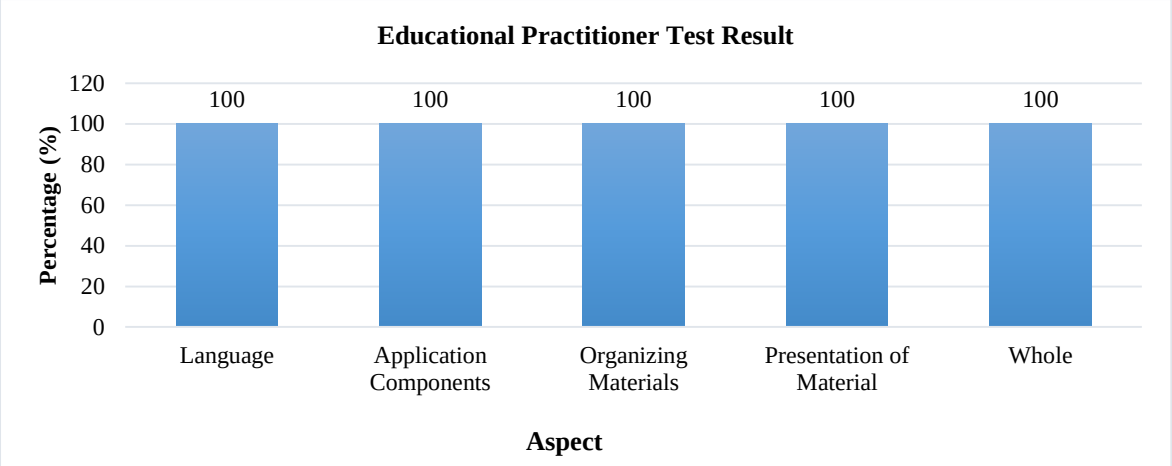

Figure 9. Education Practitioner Test Results

The results of trials conducted in Figure 9 by educational practitioners obtained a percentage of 100%. This percentage shows that the puzzle game learning media product has the eligibility criteria of "very feasible" with the qualification that it can be tested. Based on the results of trials by educational practitioners, puzzle game learning media products can be tested on students.

Data collection was carried out in the learning process outside the network and was held in three meetings facilitated by the class IX social studies teacher. Before the trial, students must download and install the puzzle game application on their Android smartphone. Next, the puzzle game learning media is applied according to the material prepared in the learning activity. After the learning process is complete, student response questionnaires are distributed containing statements to obtain information on the appropriateness level of the learning media being tested.

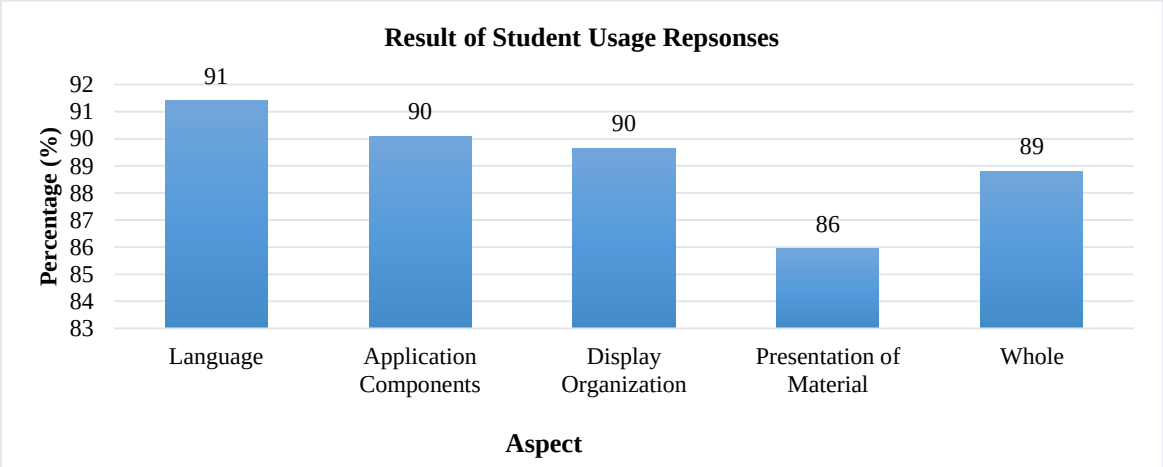

Figure 10. Results of Student Usage Responses

Based on the data in Figure 10, puzzle game learning media products have a feasibility percentage of 89%. This percentage shows that the puzzle game learning media, regarding trial use, has reached the "very feasible" criteria. The results of student responses show that the puzzle game learning media is very interesting and can encourage motivation. Knowing and understanding the

material and its operations will be easier for students. Therefore, puzzle game learning media is suitable for learning activities on the location and area of the Asian continent and other continents.

Evaluation

Evaluation is the final stage in the ADDIE development model, which aims to evaluate whether existing learning media developed successfully by the initial objectives of the research. The ADDIE model evaluation stage is carried out as the final stage in a series of learning media development where there are several series of activities that need to be carried out. The following is an explanation of the evaluation carried out by researchers at each stage of ADDIE. a) Evaluation of the analysis stage: after conducting a complexity analysis and analysis of student needs, the supervisor will evaluate the analysis of the objectives obtained. b) Evaluation of the design stage is done by consulting the results of learning objectives, material formulation, questionnaire sheet instrument design, test question instrument design, and storyboards with the supervisor. c) Evaluation of the development stage is carried out by an expert validator using a questionnaire sheet to measure the suitability of the puzzle game learning media. In the expert validator review, deficiencies were still found, such as many typos, the images not being specific, and the material in the learning media not encouraging high-level thinking. d) Evaluation of the implementation stage is done by filling out a questionnaire by educational practitioners and students. Reviews from educational practitioners show that using puzzle game learning media is interesting because it invites students into the material so that it can be conveyed well. However, it is still necessary to be more varied in its implementation. Reviews from students show that puzzle game learning media helps students understand the material with the help of the features provided. However, shortcomings still need to be found, including unavailable sound in the video and map images that cannot be zoomed. Evaluation is carried out at all stages of ADDIE model development.

Effectiveness Analysis

The effectiveness test was carried out to measure the level of success in using puzzle game-based learning media to improve student learning outcomes. The effectiveness level was analyzed by conducting a pretest and posttest on the test subject class, namely the experimental class, namely class IX A, and the control class, namely class IX B. The pretest is used to determine student learning outcomes before it is given treatment using puzzle game learning media. Meanwhile, the posttest assesses student learning outcomes after being treated using puzzle game media. Implementing puzzle game learning media was carried out in three meetings. In the first meeting, a pretest was given to students to measure learning outcomes and students' understanding of the material on the Asian Continent and Other Continents. At the second meeting, learning was carried out in the experimental class using puzzle game learning media. Meanwhile, for the control class, the learning process is carried out using conventional methods using student books as media. At the third meeting, students in both the experimental and control classes were given posttest questions to see the increase in student learning outcomes and understanding after using puzzle game learning media for the practical class and conventional methods for students in the control class.

Students' pretest and posttest results were analyzed using normality and homogeneity tests. In the normality test, the results showed that the experimental class pretest value showed a value of (Sig.) 0.108, the experimental class post-test showed a value of (Sig.) 0.109, the control class pretest showed a value of (Sig.) 0.78 and the control class posttest showed a value of (Sig.) 0.135. The results of the Kolmogorov-Smirnov normality test for students' pretest and posttest in both the experimental class and control class, the data shows (Sig.) > 0.05, so the students' pretest and post-test data can be said to have a normal distribution.

Pretest and posttest homogeneity tests for students in all classes showed a value (Sig.) of 0.065. The homogeneity test results show 0.065 > 0.05, so it can be said that the students' pre-test and post-test score data are heterogeneous in Table 2. Once it is known that the results of the normality test in both classes are proven to be normally distributed and the results of the homogeneity test in both classes are heterogeneous, then the paired sample t-test can be carried out to test the hypothesis that has been prepared previously.

Table 2. Paired Sample T-Test Results Pretest and Posttest Results

No.	Pair	Mean	Std. Deviation	Std. Mean Error	95% Confidence Interval of the Difference		t	df	Sig. 2 tailed)
					Lower	Upper			
1	Experimental Pretest – Experimental Posttest	-25.156	15.160	2.680	-30.622	-19.691	-9.387	31	.000
2	Control Pretest – Control Posttest	-13.438	15.525	2.744	-19.035	-7.840	-4.896	31	.000

Based on the paired sample t-test Results in the SPSS application with a significance level of 5%, the Sig value is obtained two-tailed and shows the e $\leq$ 0.05. The probability results indicate hypothesis H0 is rejected and Ha is accepted, meaning there is effectiveness in using puzzle game learning media in improving the learning outcomes of class IX students in one of the State Middle Schools in District X.

Discussion

Puzzle game learning media is effectively used in the classroom learning process to become an alternative solution to problems primarily related to the learning process. The lack of innovative and varied learning media can make students easily bored, lose learning motivation, and reduce student interest in learning (Ciputra et al., 2020). The use of puzzle game learning media stimulates active student involvement. Apart from that, students are encouraged to be more enthusiastic and enthusiastic about the learning process from start to finish to improve student learning outcomes (Fitra & Maksum, 2021). In their research, Kusuma et al., (2021) revealed that using gamification for learning can significantly increase student motivation and learning achievement. Meanwhile, the Gestalt Puzzle game allows players to reflect on the knowledge they have gained by describing and including this knowledge in the Gestalt Puzzle so that it can encourage students with FI-CS to play with knowledge related to learning (Hong et al., 2023). Valiente & Kim (2020) revealed that geometry games are fun to use in mathematics lessons and make learning mathematics less boring. Based on the research findings and discussion results, this study shows the same results, namely the development of game-based learning media; apart from being able to reduce the level of boredom and increase student learning motivation, the development of game-based learning media can also improve learning outcomes significantly and make learning activities more enjoyable, interactive and fun because students can be directly involved in learning activities.

CONCLUSION

Based on the findings in this research, the development of puzzle game media is by the complexity analysis and user needs analysis that researchers have carried out. Through statistical analysis, using the paired sample t-test, the results were found to be Sig. Two-tailed 0.000 < 0.05 means that Ha is accepted and H0 is rejected. This means that there is effectiveness in using puzzle game learning media in improving the learning outcomes of class IX students at one of the State Middle Schools in District X. The use of puzzle game teaching media in the learning process has been proven to improve student learning outcomes. There is a difference between the results of the pretest scores for the experimental class and the control class and the posttest scores for the practical class and the control class, where in the suitable class, there was a higher increase in scores compared to the control class.

The following are some suggestions made in connection with the development of puzzle game learning media. Obstacles that arise when using puzzle game learning media include the limited use of cellphones at school so that the learning process becomes slightly disrupted, time constraints, and accessing puzzle game learning media where not all students can download the application. Based on these obstacles, the method used by researchers is to use an LCD projector that displays puzzle game learning media. Consider the duration of learning time so that teaching and learning activities

are completed on time. The researcher lent the researcher's cellphone to students who needed help downloading the puzzle game learning media application so that students could continue paying attention to the lesson.

Based on the findings of this research, there are several limitations in this research and development, namely the use of only one sub-material so that there is a need to expand the material, the implementation of the use of puzzle game learning media in only one experimental class, the lack of elements in puzzle game teaching media such as not there is a scoreboard or ranking board for all players that reflects student performance, a limited number of quizzes, no world explore feature in the material menu display. Recommendations for further research and development include adding material, utilizing innovative AR (Augmented Reality) technology features and adding digital videos with a more attractive appearance, being able to further develop elements of the quiz feature by adding several puzzle patterns at a higher level or a more challenging level, adding a scoreboard or leaderboard that allows students to continue the game at a higher level, adding references to the material menu and product presentation to create more interactive and innovative products according to student's needs so that students are more motivated to use learning media products in the learning process.

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