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Design of TePytha-App to Improve Mathematics Learning Achievement in Pythagorean Theorem Material

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ABSTRACT
Learning media is one of the factors in improving student achievement. For this reason, learning media need to be developed along with the development of technology according to the needs of students. The purpose of this research is to design an android-based learning media in the form of a learning application to improve students' learning achievement in mathematics. Sources of data in this study were class VIII SMP Negeri 1 Gamping, material expert validators, and media expert validators. The instruments used in this study are interview guidelines, observations, questionnaires, midterm assessment (PTS) test results, material expert validation instruments, and media expert validation instruments. The data analysis technique includes the stages of data presentation, data reduction, and concluding. The results in this study show that (1) students' mathematics learning achievement tends to be low. This can be seen from the average value of the Middle Semester Assessment (PTS) of students which is only 56.72 while the Minimum Completeness Criteria (KKM) is 75. So it is necessary to develop android-based learning media; (2) application development assisted by Microsoft PowerPoint, iSpring, Website 2 APK Builder, and Java; (3) TePytha application contains the features of the home page, main menu, competencies to be achieved, introduction to Pythagoras, material menu, learning videos, quizzes, and exercises; (4) the results of the validation of material experts and media experts indicate that the product is valid to use with an average category is good. The research will proceed to the implementation and evaluation stages.

***Keywords**: Android based application; Learning achievement*

INTRODUCTION
Education has an important role in building an intelligent and quality society. This is because education is a thing that greatly affects the progress of the country(Dewi and Izzati, 2020). In-Law No. 20 of 2003 article 3 of the National Education System explained that the purpose of education is to develop the potential of students to become human beings who believe and fear God Almighty, be noble, healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens. Therefore, education must continue to be pursued so that the hopes in education can be achieved.

One of the educational processes is learning. According to Gagne in (Santoso, 2020), learning is a system that intends to help learners in the learning process, which consists of a series of events arranged and designed in such a way as to provide influence and support to the learning process of learners who are internal. In school learning, students will study a variety of subjects that have been set by the Ministry of National Education and the school. One of the subjects that play an important role in the world of education is mathematics.

Mathematics is considered very important, so in the education curriculum in Indonesia mathematics is one of the mandatory lessons that must be learned by students (Mathematics learning in schools aims to equip students to be ready to face changing living conditions by studying behaviors based on logic, rationale, critical thinking and the ability to apply mathematical thinking patterns in everyday life (Dewi and Izzati, 2020). However, the real condition of math learning in schools so far often experiences problems that must be addressed immediately (Muniasih, 2019). Furthermore, Muniasih

(2019) said that the problems that occur in the learning process result in low student learning . Whereas according to Olivia (2011) in (Marweni, 2021) learning achievement is the culmination of student learning outcomes that reflect learning outcomes against set learning goals.

Based on the results of an interview on September 23, 2021 with state junior high school math teacher 1 Gampingsaid that the results of learning mathematics students in the online learning period (online) currently showed there was a slight increase in the average student learning achievement, but the problem is the increase in the average student value is because students in solving math problems provided by teachers only rely on answers available on the internet. Students' learning achievements are then proven by the results of the Midterm Assessment (PTS) which was held on September 28, 2021. Out of a total of 126 students consisting of 4 classes obtained an average of 56.72 which is still far from the Minimum Completion Criteria (KKM) that has been determined by the school, which is 75. Based on the data shows that students' learning achievement in math subjects is still low.

Efforts that teachers can make to improve student learning achievement are by the use of learning media (Ekayani, 2017). The medium of learning is anything that can distribute information effectively and efficiently in the learning process (Istiqlal, 2017). Meanwhile, according to Saraswati and Novallyan (2017), learning media is a medium in the form of learning resources or physical means that contain learning and can be used by students to support the teaching and learning process. The use of learning media in schools is influenced by the development of increasingly advanced technology, thus providing a great challenge for teachers to continue to show their role in educating their students in the industrial era 4.0 (Oktarina and Sahono, 2020). The same thing was also conveyed by (Handayani and Rahayu, 2020) that the media used in learning is useful as an intermediary tool in delivering the subject matter, so that students can receive the learning more easily.

NCTM explains that the importance of the use of technology in mathematical learning affects teaching as well as improving students' learning processes (Heru and Yuliani, 2021). It is also mentioned by Sakat (2012) in (Oktarina, 2020) that the use of technology in learning has a significant influence. One of the technologies that are growing rapidly is information and communication technology such as Smartphones with android operating systems. Cahyani and Patrikha (2019) said that according to *IDC's Smartphone Market Share* data, Smartphones with android operating systems ranked first with a large percentage in 2018 was 85.1%. But the number of Smartphone users among students is not followed by the ability of educators in utilizing Smartphones as a medium of learning (Ismanto et al, 2017). This is like the results of interviews conducted by researchers at related schools that teachers cannot develop smartphone technology-based learning media because of their lack of knowledge of technology. From this, so it is necessary to develop android-based learning media in an effort to improve student learning achievement.

In this study, the development of the learning medium focused on the material of the Pythagorean Theorem. The Pythagorean Theorem material is an essential material in mathematics that is important for students to understand because it is used to study subsequent material (Maryana, 2019). However, the Pythagorean theorem becomes a material that is considered difficult by students because they have difficulty solving problems (Wulandari and Riajanti, 2020). Furthermore, Wulandari and Riajanti (2020) said that the factors that make students have difficulty are students are not used to writing down what is known and asked from the problem, learners are not used to inferring a problem of mathematics problems, and conceptual errors in understanding material concepts.

The things that are considered application development to improve student learning achievement is because the application has been proven effective in improving student learning achievement (Marweni, 2021). Other research conducted by (Oktarina and Sahono, 2020) also showed that the use of android-based learning media is effective to improve learning achievement because there is a significant difference between the achievement of learning control classes and experimental classes. So the goal in this study was to design an android-based learning medium under the name TePytha-APP to improve students' learning achievement on Pythagorean Theorem materials.

METHOD

The type of research used is research and development (R&D) using the ADDIE development model developed by Dick and Carry in the 1990s. This model uses 5 stages, namely: (1) analysis; (2) design; (3) development; (4) implementation; and (5) evaluation. The focus of this research was designing learning applications to improve the achievement of learning mathematics in the material of the Pythagorean theorem. The subjects in this study were class VIII junior high school learners. Sampling is

done by purposive sampling technique, namely class VIII B and VIII D. The research site was conducted at SMP Negeri 1 Gamping, Indonesia. Data collection techniques use interviews, observations, and midterm assessment results (PTS). Interviews and observations are conducted to class VIII math teachers and learners to get information about learning achievement, student characteristics, and learning media needs. While the results of PTS are used to find out the learning achievement of students. The data analysis used is qualitatively de-destructive from Miles and Huberman. Figure 1 is the development course.

RESULT AND DISCUSSION

Result

- Analysis Phase

  The first stage of TePytha-App development is analysis. At the analysis stage, there are problems that show that: (1) students' learning achievement still tends to be low; (2) The large number of Smartphone users among students is not followed by the teacher's ability to utilize smartphones as a medium of learning; and (3) Pythagorean theorem material is considered difficult by students because of teaching that requires students to memorize formulas, as a result students are unable to solve problems systematically. Based on the results of questionnaires given on November 24, 2021 to 48 respondents showed that 91.8% of students were interested in the mathematical material being made in the form of an application and 85.4% of students were interested in using it. In the analysis of development aspects, the learning media desired by students is a medium that has several features such as: material, examples of questions and discussions, quizzes and exercises, learning videos, and pictures. The competency analysis of Pythagorean theorem material is listed in Permendikbud (2018). The basic competencies contained in the Pythagorean theorem material are found in Table 1:

Table 1. Basic Competence

No	Basic Competence
3.6 4.6	Explain and prove the Pythagorean and Pythagorean triple theorem Solve problems related to the Pythagorean theorem and pythagorean triples

- Design Phase

  The design phase is the second stage in the development of TePytha-App. Product planning is made based on the results of analysis that has been done at the analysis phase. The TePyha application is designed using Microsoft PowerPoint as the main media, iSpring to create exercises, Website 2 APK Builder to convert files into applications, and Java as a programming language.The main sections contained in the TePytha app are the home page, instruction, main menu, competencies, material menu, learning videos, quizzes, and exercises.

  The home page displays the name of the learning application is "TePytha" which stands for the Pythagorean theorem. The home page is shown in Figure 1.

Figure 1. Home Page

On the main menu there are 6 buttons, namely competence, introduction to Pythagoras, materials, learning videos, quizzes, and exercises. On this menu students or app users can choose what menu they will open. At the top end, there is a hint button to provide instruction to students or application users. The main menu and instruction are shown in Figure 2.

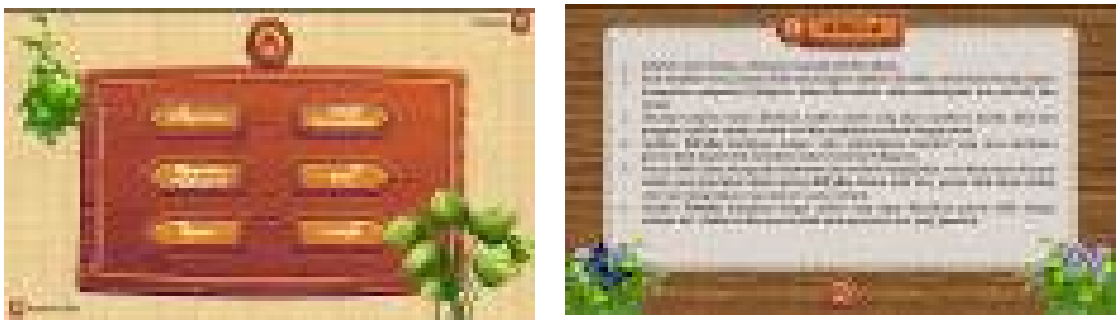

Figure 2. Main Menu and Instruction

The competency menu contains Core Competencies (KI), Basic Competencies (KD), and Competency Achievement Indicators (IPK) which are used to see the achievement of the material that must be studied by students. The competence is shown in Figure 3.

Figure 3. Competencies

The material menu will display 6 chapters of the Pythagorean theorem material that students will learn. The six chapters are Pythagorean sounds, Pythagorean formulas, Pythagorean triples, types of triangles, side ratios in right and special triangles, and Pythagoras in everyday life. Students can choose what material they will open and study. TePytha-App also contains learning videos to support students in learning so that students can understand the material better. The material menu and learning video are shown in Figure 4.

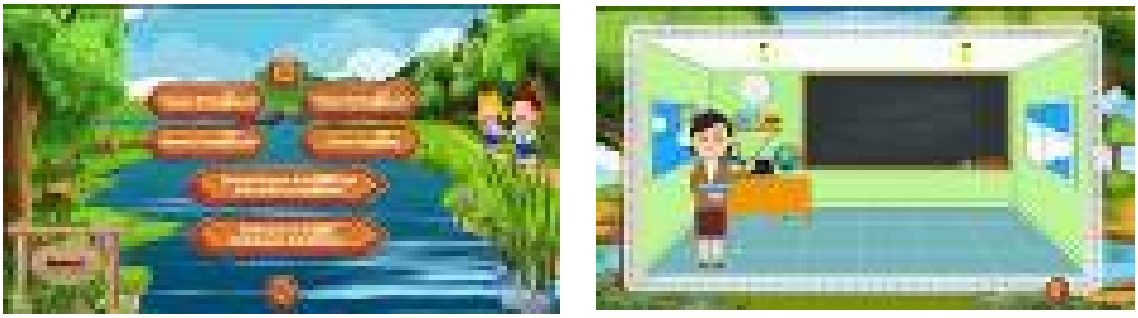

Figure 4. Material Menu and Learning video

The TePytha-App also includes quizzes and practice questions. In the quiz menu, there are 5 quizzes according to the chapters in the Pythagorean theorem material. Each quiz consists of five questions. Students must answer correctly in order to continue to the next number. This quiz is intended to help students better understand the material in each chapter. The exercise menu is used as

a student evaluation material to measure their understanding of the Pythagorean theorem material. The exercises are done by students after studying all the material. The number of questions in the exercise is 20 questions. At the end of the exercise, students will get a score according to the results of the work. Quizzes and exercise are shown in Figure 5.

Figure 5. Quizzes and Exercises

- Development Phase

At this stage, validation is carried out by material experts and media experts to assess the quality of the developed product and obtain suggestions and input to improve and perfect the product. Feedback and suggestions about the product are then followed up. From the results of the validation questionnaire, there are several opinions about the learning application contained in Table 2 below.

Table 2. Feedback and Suggestions and Follow-Up

No	Feedback and Suggestions	Follow-Up
1	The background on the main menu is changed so it's not plain	The background on the main menu is replaced with a pictorial background
2	Before entering the quiz, you can add "are you sure you want to take the quiz?"	Adding questions according to expert opinion before entering quizzes
3	Add instructions regarding buttons Sample button replaced and repaired	Added instructions regarding buttons
4	Sample button replaced and repaired	Changed the sample button to a more interesting one

The results of the assessment of learning applications were obtained from the validation instrument of material experts and media experts using a Likert scale. After the validation results are obtained, the results will be categorized by the following table of assessment criteria.

Table 3. Material Expert Assessment Criteria

No	Average Score	Classification
1	$X > 58.8$	Very Good
2	$47.6 < X \leq 58.8$	Good
3	$36.4 < X \leq 47.6$	Enough
4	$25.2 < X \leq 36.4$	Less
5	$X \leq 25.2$	Very Less

Media expert assessment criteria are categorized in Table 4 below.

Table 4. Media Expert Assessment Criteria

No	Average Score	Classification
1	$X > 67.2$	Very Good
2	$54.4 < X \leq 67.2$	Good
3	$41.6 < X \leq 54.4$	Enough
4	$28.8 < X \leq 41.6$	Less
5	$X \leq 28.8$	Very Less

The result of the validation of the TePytha-App design is shown below:

Table 5. The Result of Material Expert Validation

Assessors	Position	Score	Criteria
Ageng Triyono, M.Pd	Lecturer at STKIP Kusuma Negara	61	Very Good
Fitria Desi Nurhadiyani, S.Pd	Teacher in Mathematics study at SMP N 1 Gamping, yogyakarta	53	Good
Average		57	Good

Table 6. The Result of Media Expert Validation

Assessors	Position	Score	Criteria
Dr. Suharno, S.Pd., S.Pd.T., M.Pd.	Lecturer in Mathematics Education at Mercu Buana University of Yogyakarta	72	Very Good
Bayu Sudarmaji, S.Pd	Manager of CV ASA Multimedia and Principal of SMK Assalafiyah Sleman, Yogyakarta.	57	Good
Average		64.5	Good

From Table 5 and Table 6 it can be concluded that the TePytha-App design is in good criteria. So the TePytha-App design is declared valid.

Discussion

Based on the above results show that the design of android-based learning media is worth using in learning to improve student learning achievement. This is in line with Munir's opinion (2012) in (Marweni, 2021) that android-based media has several advantages, namely: 1) the message is conveyed clearly because it occurs concretely; 2) cause communication between the senses; 3) The inclusion of images, letters, sounds, videos, and animations can make it easier for students to understand and remember; 4) make learning more flexible so that it becomes more effective and efficient; 5) it can save time, cost, and energy.

The existence of TePytha application design can make teachers motivated to develop learning media creatively so as to make the student learning atmosphere more interesting, fun, and not boring.

Good media will keep students active in providing responses, feedback, and encouraging students to practice correctly (Andrizal and Arif, 2017).

Things that are convincing that the use of android-based learning media is very feasible to use as a student learning medium because there has been similar research, namely the results of research conducted by Handayani and Rahayu (2020) entitled "Android-Based Interactive Learning Media Development Using I-Spring and Apk Builder". The research shows that the level of learning media eligibility validated by media experts reaches 94.44% (very feasible) and material expert validation reaches 95% (very feasible). In addition, android-based media turned out to be effective in improving student learning achievement such as the results of research conducted by (Marweni, 2021) with the title "Android-Based Interactive Multimedia Development To Improve Geography Learning Achievement in Class X Students in State High School 1 Pagar Alam". The results of the study concluded that android-based media developed feasible and effective to improve student learning achievement.

CONCLUSION

Based on the research that has been done, the results show that (1) students' mathematics learning achievement tends to be low. This can be seen from the average value of the Middle Semester Assessment (PTS) of students which is only 56.72 while the Minimum Completeness Criteria (KKM) is 75. So it is necessary to develop android-based learning media; (2) application development assisted by Microsoft PowerPoint, iSpring, Website 2 APK Builder, and Java (3); the TePytha application contains the start page features, main menu, competencies to be achieved, introduction to Pythagoras, material menu, learning videos, quizzes, and practice questions (4) the validation results of material experts and media experts show that the product is valid to use with the average category is good. The research will proceed to the implementation and evaluation stages.

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