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Developing a Realistic Learning Approach on Mobile-based Apps: An Ethnomathematics *Tedhak Siten*

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ABSTRACT

Realistic mathematics learning by utilizing culture as well as integrating technology can be used as an ideal starting point for learning. This study was intended to develop a mobile learning-based mathematics device with a realistic learning approach in the context of the *Tedhak Siten* ceremony to improve students' critical thinking skills. This type of research was development research that refers to the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The study used the mobile learning application, the pretest, and post-test questions, in accordance with the expert validation questionnaire, the media expert validation questionnaire (3 experts), and the student response questionnaire from 32 students. The results revealed that the validity aspect obtained a good category from the media and material expert validator. It obtained a good category from the media expert validators and material experts. It turned out that the media expert's score was 58 and the material expert's 192. Both scores were in a Good category, thus the application was declared valid to be used. Furthermore, the practical aspect of students as users obtained a total score of 2055 and was included in the good category. The effectiveness aspect obtained a significant increase in pretest to posttest scores. It was obtained that the increase in the results of the pretest to the results of the posttest was 24.46. Since there is an increase in testing, it can be concluded that the mobile learning developed is effectively used for learning mathematics. Based on the results, mobile learning has met all the product quality criteria, namely valid, practical, and effective. Therefore, mobile learning with a realistic approach to mathematics using the *Tedhak Siten* ceremony can improve students' critical thinking skills and can be used for learning.

1. Introduction

Mathematics is a subject that is considered difficult, scary, and boring (Maswar, 2019). However, mathematics is a field of study that has an important role in education (Rofii et al., 2018). The importance of mathematics is due to its various applications in art, science, finance, health, and recreation (D'Ambrosio, 2007). In mathematics learning, students are accommodated to gain understanding through experience about the properties that are owned and not owned by a set of objects (abstraction) (Nuryadi, 2018). To have the ability to think logically, analytically, systematically, critically, and creatively as well as the ability to work together as a provision in solving problems in their lives and as provisions for living in the future students need to be exposed to Mathematics.

In the Content Standards and Graduate Competency Standards (Depdiknas, 2006) it is stated that the provision of mathematics subjects aims to make students have the understand mathematical concepts, explain the relationship between concepts and apply concepts or logarithms flexibly, accurately, efficiently, and precisely in problem-solving, using reasoning on patterns and traits, performing mathematical manipulations in making generalizations, compiling evidence, or explaining mathematical ideas and statements, solving problems which include the ability to understand problems, design mathematical models, complete models, and interpret the solutions obtained, communicating ideas with symbols, tables, diagrams, or other media to explain the situation/problem, and having the nature of appreciating the usefulness of mathematics in life, namely having curiosity, attention, and interest in mathematics lessons as well as a tenacious and

confident attitude in problem-solving. The general objective of learning mathematics at the primary and secondary education levels is to emphasize setting the setting and shaping student attitudes. The general aim is to emphasize skills in the application of mathematics, both in everyday life and in helping to learn other sciences disciplines.

The ability to think critically becomes one of the provisions that must be taught in mathematics. Is that mathematics is one of the subjects that can develop this ability (Sulistyowati et al., 2019; Setiana et al., 2021). Critical thinking ability is one of the important skills in the 21st century (Aizikovitsh & Amit, 2010). Critical thinking can be construed as thinking rationally in assessing something by gathering as much information as possible before making a decision or taking action (Howard et al., 2015). However, based on the results of interviews with the XII grade teacher of SMA Negeri 1 Sedayu, it was revealed that students still had difficulty understanding, illustrating, finding, analyzing, and evaluating math problems. This is evident from the mathematics problems that contain indicators of critical thinking skills given to 32 students; only 15 students could solve them. It showed that the critical thinking skills of some students were still low.

In mathematics learning, critical thinking skills can be developed if students are routinely faced with a problem so that they are trained in solving it (Azwar, 2021; Sanders & Moulenbelt, 2011). This kind of learning can be done if the content and context of learning are related to the daily activities of students (Laurens et al., 2019). One learning approach that can be applied to develop critical thinking skills is realistic mathematics learning (RME), or what is known in Indonesia as Indonesian Realistic Mathematics Education (PMRI). RME originated from Freudenthal's idea in 1971, which said that mathematics is part of human life so students should be allowed to find out the importance of mathematics by managing and processing real-world situations related to mathematics (Hauvel-Panhuizen, 2003). PMRI refers to mathematics proficiency according to the 2003 Ministry of National Education's *Balitbang* competency standards, namely reasoning, communication, problem-solving, and linkages between subjects (Najwa, 2018). The characteristics of PMRI are the use of context in exploration, use of models, use of student contributions and creations, interaction, relation, and using the characteristics of Indonesian nature and culture (Zulkardi et al., 2020). The mathematics learning that relates to the surrounding culture is ethnomathematics (Astuti et al., 2019; D'Ambrasio, 2001). There are some stages of ethnomathematics-based education such as exploration, mapping, explanation, and reflection (Risdiyanti & Prahmana, 2018).

Considering the previous studies, it seems plenty of spots can be explored deeply regarding critical thinking skills in learning mathematics. For this reason, the study intends to develop mobile learning with a realistic learning approach with the *Tedhak Siten* ceremony setting as a context for learning and the final target is to develop students' critical thinking skills by maximizing their learning activities.

2. Literature Review

2.1. Mathematics as Cultural Knowledge

The popular definition of culture is the result of human creation, taste, and initiative. According to Hofstede & Hofstede (2005) "Culture is a catchword for all those patterns of thinking, feeling, and acting referred to in the previous paragraphs. Not only activities supposed to refine the mind are included, but also the ordinary and menial things in life". This opinion comes up that culture is a slogan for all forms or ways of thinking, feeling, and acting in various ways. Culture is not something that only supports a good way of thinking, but includes everything ordinary or extraordinary in life.

Moreover, anthropologists view that the formation and inheritance of culture from one generation to the next is a process of transformation. It is in this process that education functions. So, the educational process is a process of cultural transformation. One of the fundamental functions of education is cultural development. Many things that are caught by human intuition (mind) from the real world and the transcendental world as objects of abstraction rely on rational (logic) and observation (sensory) experiences, as well as their life experiences. Humans direct their goals and reason to objects of mathematical knowledge in the form of concepts, principles, facts, relations, and rules contained in themselves and objectively reveal the target areas of knowledge. Because mathematics is the result of the reflection of human thought, mathematics can be said to be the result of human reason (mind) and effort (power). "Culturally relevant mathematics curriculum should focus on the role of mathematics in a sociocultural context that involves the ideas and concepts associated with ethnomathematics, using an ethnomathematical perspective for solving contextualized problems" (Rosa & Orey, 2011). The thought suggests that a culturally relevant mathematics curriculum should focus on the role of mathematics in a sociocultural context involving ideas and concepts related to ethnomathematics, using an ethnomathematical perspective to solve contextual problems.

Mathematical thoughts are in interact with culture and people, and together, form an indivisible whole. The role of Ethnomathematics, which studies mathematical thoughts, cannot be ignored in a historical-cultural context (Küçük, 2014). This opinion indicates that mathematics interacts with culture and forms an inseparable whole. The role of ethnomathematics cannot be ignored in the historical-

cultural context. Mathematics is seen as a cultural product that is developed through various activities, such as counting, placing, measuring, designing, playing, and explaining. Everyone in daily life is aware of it or not doing these activities, furthermore, it can be said that mathematics is close to everyday life. This activity is activity that is generally carried out by everyone. Consequently, mathematics as cultural knowledge is derived from these activities in a certain way (attitude) consciously and continuously.

Referring to the results of the 10th International Congress of Mathematics Education, there are several purposes for discussing ethnomathematical issues, namely:

1) What is the relationship between ethnomathematics, mathematics, anthropology, and the politics of mathematics education?
2) How to further prove that the school program has succeeded in achieving the goal of incorporating ethnomathematical ideas.
3) What are the implications of ethnomathematical research for mathematics and mathematics education?
4) What is the relationship between language differences or cultural features in generating mathematical concepts (Favilli, 2014)?

This issue is to balance the tendency of learning mathematics which is only used to solve mathematical problems itself, far from it understanding mathematical concepts is also expected to be able to be used as a provision for the formation of student attitudes and behavior in responding to various social phenomena related to culture.

Ethnomathematics is cultural mathematics that looks at the interaction of mathematics and culture (Shirley, 2015). The culture referred to here refers to a collection of norms or general rules that apply in society, beliefs, and values that are recognized by groups of people who are in the same ethnic group or national group. Kucuk (2013) made an etymological and morphological inquiry and remarked that ethnomathematics is composed of the combination of the following parts. Ethno: the culture formed society. Mathema: explaining, understanding, learning, managing, dealing, achieving, and superiority. tics: counting, ordering, differentiating, measuring, weighing, encoding, classifying, comprehending and modeling". Opinion It states that ethnomathematics consists of a combination of the following sections. Ethno: culture shaped by society. Mathema: explaining, understanding, learning, managing, dealing, achieving, and excellence. Tics: counting, ordering, distinguishing, measuring, weighing, encoding, classifying, understanding and modeling. In ethnomathematics, there are six important dimensions in learning (Rosa et al., 2016), namely:

a) Cognitive, namely the ability to think and mathematical ideas concerning the acquisition, accumulation, and dissemination of mathematical knowledge across generations.

b) Conceptual, namely providing opportunities to answer existential questions by creating procedures, practices, methods, and theories based on personal representations of reality.

c) Education is to reinforce academic knowledge when students understand mathematical ideas, procedures, and practices that exist in their daily lives.

d) Epistemology is related to the knowledge system, which is a collection of empirical observations developed to understand, understand, explain, and deal with and overcome reality.

e) Historically, that is, leading students to examine the nature of mathematics in terms of understanding how mathematical knowledge is allocated in individual and group experiences.

f) Politics aims to recognize and respect the history, traditions, and mathematical thinking developed by members of different cultural groups.

2.2. Ethnomathematics: *Tedhak Siten*

In Indonesia, there are many cultures related to mathematics, one of them is the *Tedhak Siten* ceremony. *Tedhak Siten* means descending from the ground in Indonesian. It is a ceremony performed as an expression of gratitude to God when a 7-8-month-old baby begins to set foot on the earth (Yana, 2020). The the *Tedhak Siten* image is presented in Figure 1.

Figure 1. *Tedhak Siten* (parenting.dream.co.id)

The *Tedhak Siten* or descending ground ceremony has seven interrelated sequences.

1) In the first stage, the child will be led to walk on seven *jadahs* with seven colors, namely brown, red, yellow, green, purple, blue, and white. Each color reflects the symbol of life.

2) In the second stage, the child is guided up the stairs made of Arjuna type sugar cane as a symbol of the life stages as well as symbolizing the hope that the child's character will resemble Arjuna. Sugarcane which stands for *antebing* heart means determination.

3) In the next stage, the child will be allowed to claw at the ground with his two feet in the hope that later when he grows up the child can earn sustenance.

4) In the fourth stage, children are put in a chicken cage that has been given various objects, such as money, toys, musical instruments, books, or food. The object that the child chooses describes the potential of the child. At the age of seven or eight months, children are believed to still have strong instincts.

5) In the fifth stage of the Tedak Siten ceremony, the child will be given coins with various kinds of flowers and yellow rice by the father and grandfather as a symbol and hope that the child will be blessed with abundant sustenance, but still have a generous nature.

6) In the next stage, the child is bathed with water that has been mixed with flower setaman. This step is a hope that the child will be able to bring a good name to his family. The last is the process of wearing good and clean clothes so that the child can live a good life.

The purpose of the Tedak Siten procession is to prepare children to be able to go through every phase of life. Starting with the guidance of his parents until he began to stand by themselves and have an independent life. For the ancestors, this ceremony is a form of respect for the earth where the little one stands, accompanied by chanting prayers. The hope is that children will always be given blessings and help during life. The tradition of going down to the ground is full of positive activities, in which the stages contain the value of always remembering the Creator. This ceremony is also a means of introducing children to the noble values of Javanese tradition, in addition to educating them to always be introspective and to become individuals with noble character. This ceremony is in accordance with a mathematical model, namely statistical material. Mobile learning based in the field of ethnomathematics will be targeted to develop students' critical thinking skills as a form of technology utilization so that students are more dynamic in learning. For this reason, the study intends to develop mobile learning with a realistic learning approach with the *Tedhak Siten* ceremony setting as a context for learning and the final target is to develop students' critical thinking skills by maximizing their learning activities.

3. Method

This type of research is Developmental Research using the ADDIE development model. The ADDIE model consists of five stages, namely analysis, planning, development, implementation, and evaluation (Sofyan et al., 2019; Purwoko et al., 2019). According to Tegeh et al, the implementation of the ADDIE stages is:

(a) analysis includes student competency analysis, student characteristic analysis, and material analysis.
(b) planning includes making a frame of reference on four important elements in learning design, namely students, objectives, methods, and evaluation.
(c) development, namely the activity of translating specific designs into physical form to produce prototypes of development products.
(d) implementation, namely the application of products in learning to determine the effect on the quality of learning.
(e) evaluation, namely to determine the level of product effectiveness at the end of the development stage (Sofyan et al., 2019). The product developed in this study is a realistic learning media application based on ethnomathematics mobile learning with Adobe Flash CS6 software.

The application of the Developmental Research procedure contains research and development steps using the ADDIE model which in its development stage is also carried out product feasibility testing, both validity, practicality, and effectiveness. The selection of the ADDIE model was based on the consideration that the model development was carried out systematically. The procedures for this research are as follows:

3.1. Analysis

This stage was carried out to see a description of the conditions in the field related to the teaching and learning process of Statistics Materials at SMA Negeri 1 Sedayu, Yogyakarta, and then analyzed the problem. The process carried out is:

a. Competency Analysis That Students Must Achieve

Analysis of competencies that must be achieved by students is carried out by reviewing the curriculum used and analysis related to what competencies must be mastered by students after using development products. It is focused on the analysis of Core Competencies (KI), Basic Competencies (KD), and certain additional abilities that must be mastered by students. The results of the KI and KD analysis are translated into indicators of competency achievement (GPA). Then the results of the curriculum analysis will become guidelines for developing learning media that must be achieved by students.

b. Material Analysis

The material analysis aims to determine the content and material contained in the development of learning media, namely the main materials, sub-sections of the subject matter, and sub-sections of statistics.

c. Analysis of Student Characteristics

Analysis of the characteristics of students is carried out to determine the condition of students who will be the target users of the development product, both the initial knowledge they have regarding prerequisite material and the subject matter of determinants and inverse matrices, when carrying out mathematics learning and the difficulties encountered in learning.

3.2. Design

Design activities in the ADDIE development research model are a systematic process that starts with designing the concepts and content in the product. Designs are written for each product's content. Instructions for implementing the design or manufacture of the product are attempted to be written in a clear and detailed manner. At this stage, the product design is still conceptual and will underlie the development process at the next stage.

At the design stage, the researcher designs the product according to the results of the analysis that has been done. The purpose of this stage is to design the product to be developed. The following are some of the criteria at the design stage:

a) Selection of Developed Products: The product to be developed is an android application on statistical material that has been adjusted from the results of the analysis at the definition stage.

b) Prepare the Initial Design: Preparation of the initial design that will be used in developing the application, which includes the design of the opening section, the core section, and the final section.

3.3. Development

This stage is done by writing application storyboards, developing assessment instruments, student response questionnaires, material expert validation questionnaires, and media experts.

3.4. Implementation

At this stage, the products produced in the development stage are implemented in real situations, namely in classes. At this stage, it is implemented in grade 12 SMA Negeri 1 Sedayu.

3.5. Evaluation

Evaluation occurs in each of the four stages above. At this stage, the researcher conducts evaluation activities on the quality of the product developed by the device. Data sources and subjects in this study were material expert validators, media expert validators, and twelve grade students of this senior high school in Sedayu, Indonesia. Data collection techniques in this study used interviews, observation, non-test techniques, and tests. Observations and interviews were conducted with teachers and students to obtain information about the learning model, characteristics of students, learning materials, and the curriculum used. The non-test technique is in the form of an assessment of the validity of all material, the validity of media experts, and an assessment of the practicality of students. Meanwhile, test assessment is done by giving tests to measure the effectiveness of product use. The instruments used in this study were validation questionnaires to measure product validity, student response questionnaires to measure product practicality, and pretest-posttest questions to measure product effectiveness in terms of students' critical thinking abilities.

4. Result

This section discusses the development steps that have been carried out using the ADDIE model, namely:

4.1. Stage 1. Analysis

At this stage, it was found that the curriculum used in senior high school was the 2013 curriculum with Core Competencies (KI) and Basic Competencies (KD) used in statistical materials in accordance with government decree (Permendikbud) No. 37 of 2018, namely:

Knowledge Competency 3.2:

Determining and analyzing the size of the concentration and distribution of data in the form of frequency distribution tables and histograms.

Skills KD 4.2:

Solving problems related to the presentation of measurement data and *enumeration* of frequency distribution tables and histograms. Furthermore, the minimum completeness criteria (KKM) for mathematics at this senior high school is 75, and the characteristics of students consistently require mobile learning in terms of critical thinking skills.

Ethnomathematics-based mathematics learning design was chosen as a form of attention to the existing cultural crisis (Astuti et al., 2019). Learning must have a special role in these problems so that the mathematics-learning scheme must be given a context that is acceptable to students and clarifies mathematical concepts as well as can contribute to preserving the existing culture in the community.

4.2. Stage 2. Design

At this stage, a product design according to the results at the analysis stage has been created and carried out. It started by making flowcharts and storyboards. Then, the result of the developed product is a real learning application based on ethnomathematics mobile learning that is made with Adobe Flash CS6 software with the Android AIR worksheet setting the size of 800 x 480 pixels (landscape). After the media creation is complete, it is extracted into an application that can be installed on Android with additional Adobe Air for Android software. The several views of the application design results can be seen in Figure 1, Figure 2, and Figure 3.

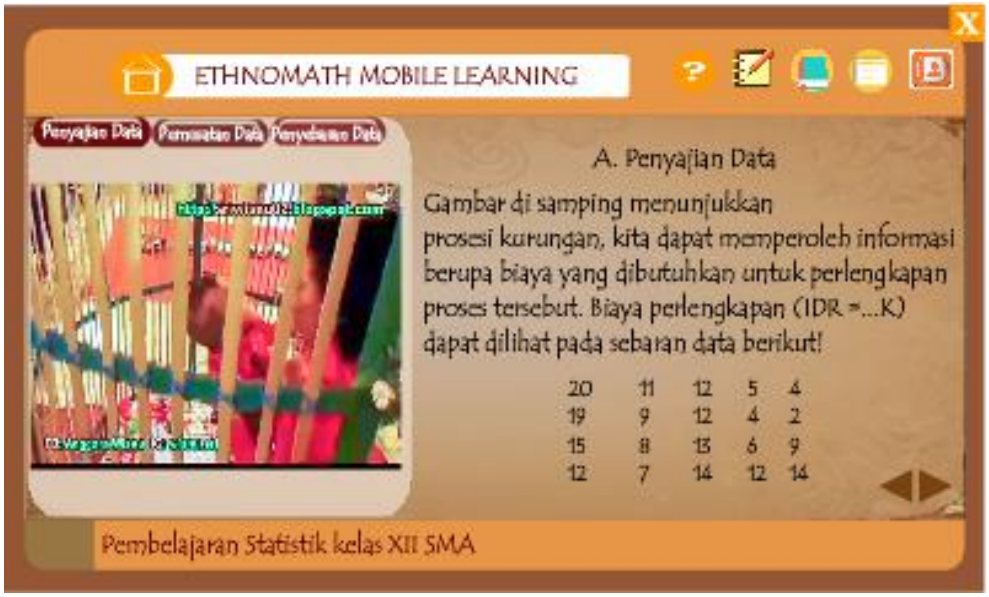

Figure 1. Display of definition *Tedhak Siten*

Figure 1 is a presentation related to the definition of *Tedhak Siten* in the application. *Tedhak Siten* or *Tedhak Siti* is one of the Javanese traditional ceremonies for a 7 month old child, which is 245 days calculated based on the Javanese calendar (7 x 35 days). *Tedhak Siten* or *Tedhak Siti* comes from the word "*tedhak*" meaning "stepping / descending" and "*siten/\siti*" which means earth/land. The ceremony is carried out according to the birthday on the answer calendar.

The purpose of this presentation is so that students can understand the meaning of the *Tedhak Siten* Ceremony. Figure 1 shows the provision of context according to the selected cultural product, *Tedhak Siten* is used as a context because the ceremony contains a mathematical model that can be used as a starting point for mathematical pursuits; this is in line with research conducted by Rully, which states that learning mathematics must be started. with context as the starting point of learning and providing an understanding that mathematics is close to daily activities (Prahmana et al., 2021).

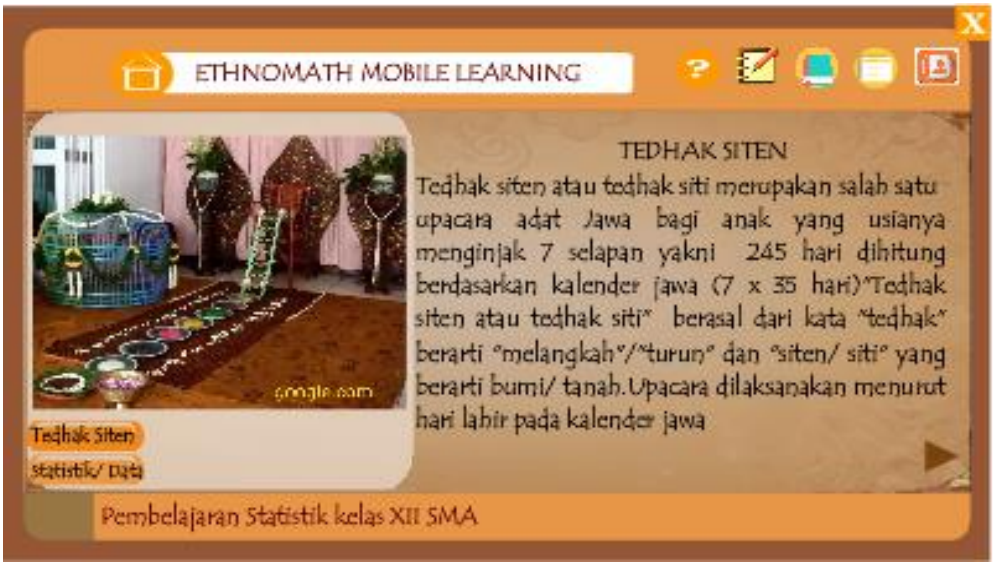

Figure 2. Display of Material

The picture in Figure 2 shows the confinement procession. We can get information in the form of costs needed for the process equipment. Equipment costs (IDR = ... k) can be seen in the following data distribution:

20	11	12	5	4
19	9	12	4	2
15	8	13	6	9
12	7	14	12	14

In the application, the ethnomathematics contained in the *Tedhak Siten* ceremony is discussed. In accordance with the studies that have been carried out, Tedha Siten is related to the material in mathematics, namely Statistics. So in this view, examples of statistical questions related to the *Tedhak Siten* ceremony are presented. This is because the application has a realistic mathematical approach so that the content of the material in the application is associated with everyday life.

Figures 2 and 3 show that the learning design on mobile devices has provided facilities that direct students to carry out learning activities using discovery learning. This method is a way of stimulating students to think mathematically and critically. This statement is in accordance with previous research, which states that learning with the discovery method can develop students' critical thinking skills in solving math problems (Numyani, 2020; Saputra & Sarkadi, 2018; Farib et al., 2019).

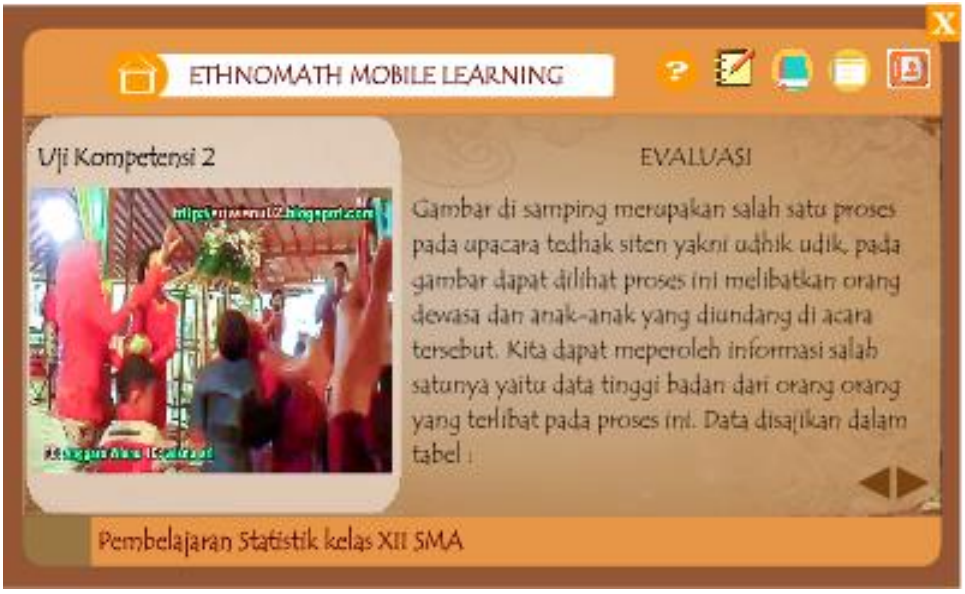

Figure 3. Display of evaluation

The picture in Figure 3 s one of the processes in the *Tedhak Siten* ceremony, namely udik adhik, in the picture, it can be seen that this process involves adults and children who are invited to the event. We can get information, one of which is the height of the people involved in this process.

4.3. Stage 3. Development

At this stage, the researcher translates the specific design at the design stage into physical form, resulting in an application that is ready for use on Android. At this stage, product validation is carried out in material experts and media experts. The results of validation by both can be seen in Table 1 and Table 2.

Table 1. Result of the media expert validation

No	Indicator	Score
1	Technical quality	27
2	Composition	10
3	Balance	9
4	Cohesiveness	12
	Total	**58**

Table 2. Result of the material expert validation

No	Indicator	Score
1	Content eligibility assessment	79
2	The feasibility of presentation	43
3	Language assessment	46
4	Ethnomathematics teaching materials	24
	Total	**192**

Based on Table 1 and Table 2, which have been converted, it is obtained a score of 58 from *media* experts meets the good category, and a score of 192 from material experts also meets the good category. Thus, the product developed is declared valid.

Qualitatively, products that are declared valid can be continued to be tested for implementation to see the effect of the treatment of learning with the teacher and student respondents. This stage is in accordance with the research conducted by Suyitno, which states that the stages in product development from the validation test can be passed on to the implementation test (Suyitno et al., 2020)

4.4. Stage 4. Implementation

At this stage, the researcher started by distributing the critical thinking skills pretest, which consisted of 3 questions about the statistical material. After that, the researcher implements the product results that have been declared valid by experts in learning mathematics. The learning was conducted in 3 meetings using ethnomathematics mobile learning with a realistic mathematical approach. Learning is carried out in 12^{th} grade at senior high school. After the learning was carried out, the researcher asked students to respond to the product used by filling out a student response questionnaire. The results of the assessment of the product response questionnaire by 32 students can be seen in Table 3.

Table 3. Result of student response questionnaire

Assessor	Score	Category
Students’	2055	good

Table 3 shows the total score of the 32 students is 2055 and meets the criteria well so that the product is declared practical to use. A practicality test is carried out to see student responses in the learning process. In the development method, this stage is a stage that can be used as a reference to see in real terms whether the learning model can be accepted by students or not (Kurniawan et al, 2018; Sogyan et al., 2019).

4.5. Stage 5. Evaluation

This stage is carried out by distributing post-test questions on critical thinking skills *consisting* of 3 questions about statistical material in class that has been applied to learning with ethnomathematics mobile learning. The results of this test are compared with the pretest to find out whether the product developed is effective or not. The results of this test can be seen in Table 4.

Table 4. Comparison results of pretest and posttest

Value	Average	Increase
Pretest	55,86	24,46
Posttest	80,32	

Table 4 shows a significant increase of 24.46 from before and after the application of learning using *mobile* learning ethnomathematics. Research using an ethnomathematics approach has a potential effect on developing students' critical thinking skills (Prahmana et al, 2021; Rosa & Orey, 2011). Critical thinking skills are reflective and reasonable thinking abilities that focus on making decisions about what we are going to do or what we believe. Critical thinking is important in relation to problem-solving. Thus, the product developed is declared effective for developing students' critical thinking skills. In this study, we find that in the *Tedhak Siten* ceremony there are several things that can be related to mathematics. This is usually called ethnomathematics. in the *Tedhak Siten* ceremony the related mathematical material is statistics. In this study, ethnomathematics at the *Tedhak Siten* ceremony was made in an android application.

The advantages of *ethno mobile learning-based learning* media are that it can be installed on smartphones, especially Android so that it is easy to carry as a learning reference, and the material on learning media provides real examples in everyday life so that students can find examples of other cultures that can be studied in mathematics, and this learning media present cultural pictures/illustrations related to mathematics material so that it will make it easier for students to visualize 2. While the lack of thematic mobile learning-based learning media is that there are still not many variations of questions related to culture and learning media can only be installed on android type smartphones.

5. Discussion

The study was conducted on the development of mobile learning with a realistic approach at the *Tedhak Siten* ceremony to develop students' critical thinking skills. The research findings show empirical evidence that the developed mobile learning can improve students' critical thinking skills. It also answers the questions in this study.

5.1. Develop mobile learning with a realistic approach *Tedhak Siten*

Tedhak Siten's mobile learning tool was developed with the help of Adobe Flash CS6and additional software Adobe Air for Android then converted to appilcation format so that it can be used on mobile devices. The development of this application was initially carried out by conducting a preliminary study, which obtained students' critical thinking skills that were still low on statistical material. In addition, students are interested if there are learning applications that relate to everyday life. Therefore, researchers develop learning applications for mathematics subjects that are associated with everyday culture or referred to as ethnomathematics.

The culture adopted is the *Tedhak Siten* ceremony. In the *Tedhak Siten* ceremony, statistical material can be linked, so researchers have made the device with statistical material.

5.2. Determine the validity of *Tedhak Siten*

After the product has been developed. The researcher developed a validation instrument for material experts and media experts. This is intended as an assessment sheet to determine whether the application developed is valid to use. In this case, the researcher asked 2 material experts and 1 media expert to provide an assessment of the developed application.

After the experts filled out the assessment sheet, the researcher conducted a test analysis of the total score obtained. It turned out that the media expert's score was 58 and the material expert's 192. Both scores were in a Good category, so the application was declared valid to be used. This is in line with the research conducted by Wijayanti & Sungkono (2017) dan Arifin et al. (2020) that the product can be declared valid if the results of the expert assessment are in the minimal category of Good.

5.3. The Practicality of *Tedhak Siten* ethnomathematics mobile

The next stage is to find out whether the product developed can be declared practical or not. This stage is carried out by providing a response questionnaire to students after they use the developed mobile learning. In this case, there are 32 students who use this application; this is indeed quite limited because the research was carried out during the covid-19 pandemic so it could not reach many respondents. After the response questionnaire was filled out by students, the researcher analyzed the test results and obtained a total score of 2055 which was included in the good category. Therefore, the developed mobile learning can be stated as practical to use. This is in accordance with the assessment conducted by Arifin et al. (2015) in his research where the product can be declared practical if it obtains a minimum score of Good.

5.4. The effectiveness of *Tedhak Siten*

Furthermore, the learning media developed must meet the effective criteria. This effectiveness test was conducted by distributing pretest and post-test questions on critical thinking skills to students on Statistics material. After analyzing the results of the test, it was obtained that the increase in the results of the pretest to the results of the post-test was 24.46. Because there is an increase in testing, it can be concluded that the learning media developed are effectively used for learning mathematics. This is in line with research conducted by Indaryati & Jailani (2015) and Rusnilawati (2016) and that learning media are said to be effectively used if there is an increase in pretest and posttest results.

Based on the results of the discussion above, the learning media have met all the product quality criteria, namely valid, practical, and effective. Therefore, mobile learning with a realistic approach to mathematics using the *Tedhak Siten* ceremony can improve students' critical thinking skills and can be used for learning.

6. Conclusions

Based on the results of the study, it can be concluded that the product assisted by Adobe Flash CS 6 and additional software Adobe Air for Android, namely mobile learning ethnomathematics on Statistics material with a realistic mathematics learning approach in *Tedhak Siten* ceremonial to develop students critical thinking skills. The development process uses the ADDIE model and has met the product eligibility criteria, namely valid, practical and effective. There are good categories of media expert validators and material experts in the validity aspect. The practical aspects of students as users are categorized as good, and the effectiveness aspect obtained a significant increase in the pretest to post-test scores. So that mobile learning-based applications can develop critical thinking skills, it is declared fit for use as constructive learning media.

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