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ETNHOMATHEMATICS TEDHAK SITEN: LEARNING DESIGN TO DEVELOP STUDENT'S CRITICAL THINKING SKILL BASED ON MOBILE DEVICES

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Abstrak: Berpikir kritis merupakan salah satu keterampilan penting di abad 21 yang dapat dikembangkan melalui pembelajaran matematika. Namun dalam praktiknya, media pembelajaran belum banyak terfasilitasi. Pembelajaran matematika realistik dengan memanfaatkan budaya serta mengintegrasikan teknologi dapat dijadikan sebagai titik awal pembelajaran yang ideal. Penelitian ini bertujuan untuk mengembangkan perangkat pembelajaran matematika berbasis mobile learning dengan pendekatan pembelajaran realistik dalam rangka upacara Tedhak Siten untuk meningkatkan kemampuan berpikir kritis siswa. Jenis penelitian ini adalah penelitian pengembangan yang mengacu pada model ADDIE (Analysis, Design, Development, Implementation, Evaluation). Sumber data dalam penelitian ini adalah siswa dan validator. Instrumen yang digunakan adalah aplikasi mobile learning, soal pretest dan posttest, angket validasi ahli materi, angket validasi ahli media, dan angket respon siswa. Hasil penelitian menunjukkan bahwa aspek validitas memperoleh kategori baik dari validator ahli media dan ahli materi, aspek kepraktisan dimana siswa sebagai pengguna memperoleh kategori baik, dan aspek efektivitas diperoleh peningkatan yang signifikan pada nilai pretest ke posttest. Sehingga pembelajaran matematika dengan aplikasi mobile learning dapat meningkatkan kemampuan berpikir kritis siswa.

Kata kunci : *Berpikir kritis, Mobile learning, Tedhak Siten*

Abstract: Critical thinking is one of the essential skills in the 21st century that can be developed through learning mathematics, but in practice, there has not been much facilitation of learning media. Realistic mathematics learning by utilizing culture as well as integrating technology can be used as an ideal starting point for learning. This study aims to develop a mobile learning-based mathematics learning device with a realistic learning approach in the context of the Tedhak Siten ceremony to improve students' critical thinking skills. This type of research is development research that refers to the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The data sources in this study were students and validators. The instruments used were the mobile learning application, the pretest, and posttest questions, the material expert validation questionnaire, the media expert validation questionnaire, and the student response questionnaire. The results showed that the validity aspect obtained a good category from the media expert validator and the material expert, the practical aspect of students as users obtained a good category, and the effectiveness aspect obtained a significant increase in pretest to posttest scores. So that learning mathematics with mobile learning applications can develop students' critical thinking skills and have potential effects.

Keywords: *Critical thinking, Mobile learning, Tedhak siten*

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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 many applications in art, science, finance, health and recreation (D'Ambrosio, 2007). In mathematics learning, students are accustomed to gaining understanding through experience about the properties that are owned and not owned by a set of objects (abstraction) (Nuryadi, 2018). One of the provisions that must be taught in mathematics is the ability to think critically. Because 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 is 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 can solve it. This shows that the critical thinking skills of some students are 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). Learning like this 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 that students should be given the opportunity 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, interactive, related, 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). And for ethnomathematics-based education, stages are exploration, mapping, explanation, and reflection (Risdiyanti & Prahmana, 2018).

In Indonesia, there are many cultures related to mathematics, one of which is the Tedhak Siten ceremony. Tedhak Siten which means descending from the ground in Indonesian, 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). This ceremony is in accordance with a mathematical model, namely statistical material. Mobile learning-based learning tools 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 researcher intends to develop mobile learning-based learning tools with a realistic learning approach with the Tedhak Siten ceremony setting as a context in learning and the final target is to develop students' critical thinking skills by maximizing their learning activities.

RESEARCH METHOD

This type of research is development 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.

Data sources and subjects in this study were material expert validators, media expert validators, and twelve grade students of this senior high school 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.

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RESULTS AND DISCUSSION

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

Stage 1. **Analysis**

At this stage, it was found that the curriculum used in this senior high school was the 2013 curriculum with Core Competencies (KI) and Basic Competencies (KD) used in statistical materials in accordance with 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 based learning tools 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.

Stage 2. Design

At this stage, a product design according to the results at the analysis stage has been created and carried out. It is starting from making flowcharts and storyboards. Then, the result of the product developed is a realistic learning application based on ethnomathematics mobile learning which 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 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).

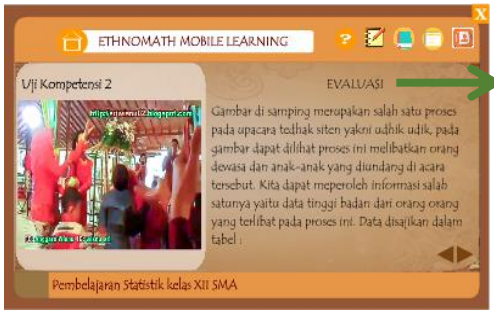
Tedhak Siten
Tedhak siten or tedhak siti is one of the Javanese traditional ceremonies for children whose age is 7 eight, which is 245 days calculated based on the Javanese calendar (7 x 35 days). Tedhak siten or tedhak siti comes from the word "tedhak" meaning "stepping / descending" and "siten / siti" which means earth/land. The ceremony is carried out according to the birthday on the answer calendar.

Figure 1. Display of Definition on Ethnomathematics Mobile Learning

Data Display
The picture on the side 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

Figure 2. Display of Statistical Material in Ethnomathematics Mobile Learning



Evaluation
The picture on the side is 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. Data are presented in tables.

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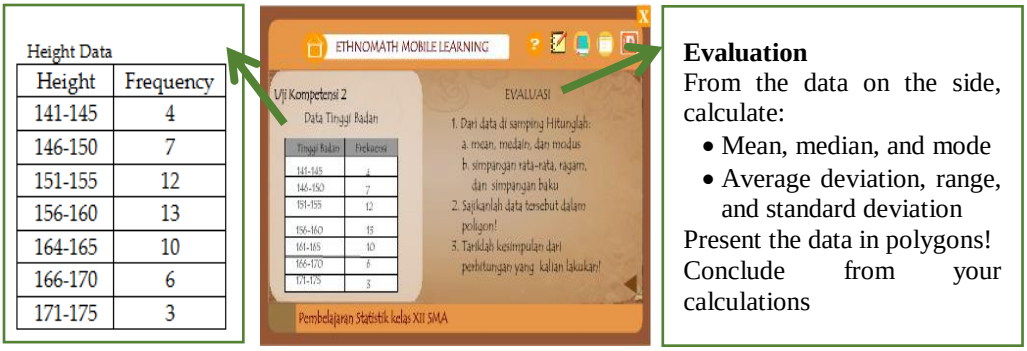

Figure 3. Display Evaluation on Ethnomathematics Mobile Learning

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 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).

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 from material experts and media experts. The results of validation by both can be seen in Table 1 and Table 2.

Table 1. Results of The Media Expert Validation.

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

Table 2. Results of material expert validation

No	Aspect	Value
1	Content eligibility assessment	79
2	Aspects of the feasibility of presentation	43
3	Aspects of language assessment	46
4	Aspects of 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)

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 twelve 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. Results Of Student Response Questionnaire Assessment

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 that the learning model can be accepted by students or not (Kurniawan et al, 2018; Sogyan et al., 2019).

Stage 5. Evaluation

This stage is carried out by distributing posttest questions on critical thinking skills *consisting* of 3 questions about statistical material in class that have 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.

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Table 4. Comparison Results of Pretest and Posttest Values Increase The Average Value

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 in developing students' critical thinking skills (Prahmana et al, 2021; Rosa & Orey, 2011). Thus, the product developed is declared effective for developing students' critical thinking skills.

CONCLUSIONS AND SUGGESTIONS

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 a constructive learning tool.

REFERENCES

Aizikovitsh, E., & Amit, M. (2010). Evaluating an infusion approach to the teaching of critical thinking skills through mathematics. *Procedia Soc. Behav. Sci.*, 2()1, 3818–3822, https://doi.org/10.1016/j.sbspro.2010.03.596

Astuti, E.P., Purwoko, R.Y., & Sintiya, M.W. (2019). Bentuk etnomatematika pada batik adipurwo dalam pembelajaran pola bilangan," J. Math. Sci. Educ., 1(2), 1-16 https://doi.org/10.31540/jmse.v1i2.273

Azwar, S. (2021). Tes prestasi: Fungsi dan pengembangan pengukuran prestasi belajar. Perpustakaan FIS, http://library.fis.uny.ac.id/opac/index.php?p=show_detail&id=2536

D'Ambrosio, U. (2001). What is ethnomathematics, and how can it help children in schools?," Teach. Child. Math. 7(6), 308-310, https://doi.org/10.5951/TCM.7.6.0308

D'Ambrosio, U. (2007). The role of mathematics in educational systems," ZDM - Int. J. Math. Educ., https://doi.org/10.1007/s11858-006-0012-1

Farib, P.M.,, Ikhsan, M., & Subianto, M. (2019). Proses berpikir kritis matematis siswa sekolah menengah pertama melalui discovery learning. J. Ris. Pendidik. Mat., 6(1), 99-117, https://doi.org/10.21831/jrpm.v6i1.21396

Heuvel-Panhuizen, M.V.D. (2003). The didactical use of models in realistic mathematics education: An example from a longitudinal trajectory on percentage. in Educational Studies in Mathematics, 54(1), 9–35, https://doi.org/10.1023/B:EDUC.0000005212.03219.dc

Howard, L.W, Tang, T.L.P., & Austin, M.J. (2015). Teaching critical thinking skills: ability, motivation, intervention, and the pygmalion effect. J. Bus. Ethics, https://doi.org/10.1007/s10551-014-2084-0

Kurniawan, H., Putri, R.I.I., & Hartono, Y. (2018). Developing open-ended questions for surface area and volume of beam," J. Math. Educ., 9(1), 157–168, https://doi.org/10.22342/jme.9.1.4640.157-168

Laurens, T., Batlolona, F.A., Batlolona, J.R., & Leasa, M. (2018). How does realistic mathematics education (RME) improve students' mathematics cognitive achievement?. Eurasia J. Math. Sci. Technol. Educ., 14(2), 569–578, https://doi.org/10.12973/ejmste/76959

Maswar, M. (2019). Strategi pembelajaran matematika menyenangkan siswa (mms) berbasis metode permainan mathemagic, teka-teki dan cerita matematis. Alifmatika J. Pendidik. dan Pembelajaran Mat, 1(1), 28–43, https://doi.org/10.35316/alifmatika.2019.v1i1.28-43

Najwa, W. A. (2018). Pendekatan PMRI sebagai gerakan literasi sekolah dalam pembelajaran matematika, Prisma, Prosiding Seminar Nasional Matematika, 1, 575-581. Retrieved from https://journal.unnes.ac.id/sju/index.php/prisma/article/view/20200

Nurmayani. (2020). The analysis of students' mathematical critical thinking ability through discovery learning models. International Journal of Research and Review, 7(11), 233-241, https://doi.org/10.52403/ijrr

Nuryadi. (2018). Persepsi siswa tentang penerapan model pembelajaran berbasis proyek ditinjau dari kreativitas dan hasil belajar siswa. Jurnal Mercumatika: Jurnal Penelitian Matematika dan Pendidikan Matematika, 3(1), 53-63, https://doi.org/10.26486/jm.v3i1.656

Purwoko, R.Y., Astuti, E.P., Arti, M.S., & Widiyono, Y. (2019). Batik nusantara pattern in design of mathematical learning model for elementary school," J. Phys. Conf. Ser., 1254(1), https://doi.org/10.1088/1742-6596/1254/1/012001

Prahmana, R.C.I., Yunianto, W., Rosa, M.,, & Orey, D.C. (2021). Ethnomathematics: pranatamangsa system and the birth-death ceremonial in Yogyakarta," J. Math. Educ., 12(1), https://doi.org/10.22342/jme.12.1.11745.93-112

p-ISSN 2089-8878; e-ISSN 2715-8276

Risdiyanti, I., & Prahmana, R.C.I. (2018). Ethnomathematics: Exploration in Javanese culture," in Journal of Physics: Conference Series, Feb. 2018, 943(1), https://doi.org/10.1088/1742-6596/943/1/012032

Rofii, A., Sunardi, S., & Irvan, M. (2018). Characteristics of Students' Metacognition Process At Informal Deduction Thinking Level in Geometry Problems," Int. J. Emerg. Math. Educ., 2(1), 89-105, https://doi.org/10.12928/ijeme.v2i1.7684

Sanders, M., & Moulenbelt, J. (2011). Defining critical thinking. Inq. Crit. Think. Across Discip., 26(1):38-46, https://doi.org/10.5840/inquiryctnews20112616

Saputra, M.A., & Sarkadi, U. (2018). The impact of discovery learning and critical thinking towards learning outcomes of Indonesian history. Journal of Historical Studies. 10(1), 31-44, https://doi.org/10.2121/TAWARIKH.V10I1.1058

Setiana, D.S., Purwoko, R.Y. & S. Sugiman. (2021). The Application of Mathematics Learning Model to Stimulate Mathematical Critical Thinking Skills of Senior High School Students," Eur. J. Educ. Res., 10(1), 509-523, https://doi.org/10.12973/eu-jer.10.1.509

Sofyan, H., Anggereini, E., & Saadiah, J. (2019). Development of E-modules based on local wisdom in central learning model at kindergartens in Jambi city. Eur. J. Educ. Res., 8(4), 1137-1143, https://doi.org/10.12973/eu-jer.8.4.1139

Sulistyowati, F., Kuncoro, K.S., Setiana, D.S., & Purwoko, R.Y. (2019). Solving high order thinking problem with a different way in trigonometry, J. Phys. Conf. Ser., 1315(1), https://doi.org/1088/1742-6596/1315/1/012001

Suyitno, S., Purwoko, R.Y., Widiyono, Y., Jatmoko, D., Nurtanto, M., & Hassan, Z. (2020). Development of learning media for automotive charging system based on Macromedia flash vocational school. Univers. J. Educ. Res., 8(11C). 64–71, https://doi.org/10.13189/ujer.2020.082308

Rosa, M., & Orey, D.C. (2011). Ethnomathematics : the cultural aspects of mathematics Etnomatemática : os aspectos culturais da matemática. Rev. Latinoam. Etnomatemática, 4(2). 32-54, https://www.revista.etnomatematica.org/index.php/RevLatEm/article/view/32

Yana, M.H. (2020). Falsafah dan pandangan hidup Orang Jawa. OPAC Perpustakaan Nasional RI. https://opac.perpusnas.go.id/DetailOpac.aspx?id=269499

Zulkardi, Putri, R.I.I., & Wijaya, A. (2020). "Two decades of realistic mathematics education in indonesia," Springer, Cham, pp. 325–340. https://link.springer.com/chapter/10.1007/978-3-030-20223-1_18