Educational apps for a prospective mathematics teacher in probability course

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Abstract. This research aims to develop an Android Package Kit (APK) to improve college students’ mathematical critical thinking skills. The APK developed does not only contain a summary of the material and evaluation questions, but also contains contextual animation, education games, appropriate reference links for supplements and college student enrichment, and online discussion groups in which some teachers can provide feedback to discuss or lead the course of discussion in study groups. This research belongs to development research refers to ADDIE. In the analysis, the design and development stage conduct several activities to prepare the design and APK devices until the revision. At the implementation and evaluation stage, the effectiveness of learning using APKs was seen using a quasi-experimental research design with pre-test post-test control group design. This study found a feature that is different from other similar applications, the “join” and “search” features. Based on testing from media experts and material experts, it shows that the design and APK devices are learning media that are suitable for use by students, as well as the average of critical thinking skills the experimental class is better than the control class.

1. Introduction
The conventional learning process (face to face with practice exercises) is always not good to improve student learning outcomes. However, the independence of students needs to be demanded so that students are more active and critical in following the learning process. One form of liveliness and creativity that can be done by using the medium of ICT (Information and Communications Technology). With this medium, all-students can do for the deepening of the material or concept that has been mastered. The new paradigm of Mathematics education requires integrated and continuous learning innovations, including using ICT media. As one example of the results of Rosenberg’s research [1] states that ICT that uses internet technology in sending a series of solutions can improve students’ knowledge and skills. This is supported by Ritz [2] stating that the application of technology is useful to assist learning and increase knowledge. This can be done by integrating technology into science and mathematics.

When the concept of science in material or expertise in applied has been obtained, students will refer to face-to-face learning, while when skills in independent learning have been obtained, students refer to online learning. In comparison, Prayito [3], in his research, concluded that ICT learning that has been carried out has a good impact that can complete the learning outcomes of students and foster student activeness. Kaino’s research results [4] state that the development of an ICT program is recommended for conceptualization and improving the ability to solve mathematical problems among students. They
explore and investigate mathematics in numerical, symbolic, and graphical learning. Pavlik’s research [5] about the use of communication and information technology for educational purposes has a positive impact on students. Another study conducted by the Center for Applied Special Technology [5] states that the use of the internet as an educational medium shows a positive impact on student achievement.

Good learning devices in the form of teaching aids continue to develop rapidly, one of which is the use of mobile learning. The results showed that mobile learning is a positive thing, but some challenges must be overcome, among others, the lack of awareness about the benefits and disadvantages of mobile learning [6]. The integration of project-based learning in the design and development of applications shows that it can facilitate students to have dominant control of their learning processes [7][8][9][10] say that APK can provide the right insights to the right people anytime and anywhere. In this study not only developed an APK that contains mathematical content that has been developed by several developers so far but emphasizes the development of APK that can train prospective mathematics teachers to be able to submit mathematical problems with the HOTS standard. Some of the results of research on mathematical critical thinking and mathematical critical thinking disposition include [11][12][13][14][15][16][17] suggesting the importance of critical thinking and disposition for students. Research on APK for learning includes [18][19][20][21][22]. Some research on ICT for learning, including Iskandar et al. uses mobile learning and the result is students can get more understanding and student achievement increase by using mobile learning [23]. Researchers have not used an integrated APK to improve students’ mathematical critical thinking skills.

The problems of this study are as: What is the appropriate APK design and tool to support the improvement of mathematical critical thinking skills of mathematics education students at Universitas PGRI Semarang: Are the developed APK designs and devices valid?: Can the APK implementation improve the mathematical critical thinking ability of students in effective mathematics education?.

2. Methods
This research is classified as development research. This research has two phases. The first phase includes several activities, namely the design of the APK design and tools until the revision stage before the Implementation stage, namely Analyze, Design, and development. The second phase is the Implementation and Evaluation stage. At the implementation stage, it will be seen the effectiveness of learning using APKs that were developed using a quasi-experimental research design with a pretest-posttest control group design by taking a sample of mathematics education students at Universitas PGRI Semarang.

3. Results and discussion
3.1. Preliminary study results
Based on interviews and observation have researched with sources, which is by two lectures found that students in the study of probability theory are still experiencing difficulties in mathematical problem solving that students must be critical thinking mathematically. In contrast, student of mathematics education is required to have the ability HOTS (one of the critical thinking mathematically) to support the profession as a teacher later. Hence, the researchers carry out research and development android kit package to improve students’ critical thinking. Before carrying out research, researchers make the following preparations: First, compile instruments in the form of test questions, guidelines for scoring test questions, media expert questionnaires, material expert questionnaires, and student questionnaires. Second, choosing a research sample using cluster random sampling techniques and selected two classes as a research sample, namely 2C as an experimental class and 2D as a control class.

3.2. Product design
The product produced in this research is learning media in the form of an Android package kit. Figure 1 and figure 2 are the screenshot and description of the design of mathematics learning media products.
3.2.1. Application file. The application file of this research product is an Android Package Kit that can be installed with a device with the Android operating system. After installing, there will be an MPP icon on the Android app and the application can be run (see figure 1 and figure 2).

3.2.2. Beginning section. In the beginning, there is an opening intro that shows the campus building and the identity of Universitas PGRI Semarang, Mathematics Education and a button to enter the application menu page.

3.2.3. Menu section. The menu in this application contains the main menu consisting of material, worksheet methods, for example, join (WhatsApp group), search (looking for references), and there is a button (x) for the application exit menu (quit).

3.2.4. Quit section. Quit on this application does not directly exit the application, but there is a question to convince the user whether they want to exit/not. When you click “yes” it will exit the application; when you click “no” it will return to the main menu shown in figure 1.

3.3. Product design

3.3.1. Material and media validation analysis. Expert validation test material and the media using validation sheet, which is divided into four aspects: general aspects, presenting aspects of learning,
language aspects and feasibility of graphic aspects. From these four aspects, there are a total of 25 assessment indicators. The results of expert validation are shown in Table 1.

| Indicator                              | Expert score | Percentage | Average | Criteria |
|----------------------------------------|--------------|------------|---------|----------|
| General aspects                        | 17 17 18     | 91 91 84  | 89%     | Very good|
| Learning presentation aspects          | 29 29 29     | 88 88 88  | 88%     | Very good|
| Aspects of language feasibility        | 23 22 23     | 88 84 88  | 87%     | Very good|
| The eligibility aspect of graphics     | 38 36 40     | 84 81 88  | 84%     | Good     |
| Total                                  | 107 104 110  |            |         |          |

Analysis process an overall analysis is made in the assessment by learning media experts. The results are 85.6% (1). That can be searched for: \[ \sum (\text{answer} \times \text{weights per choice}) = 321; N = 25 \times 3 = 75. \] Highest weight = 5. So it can be calculated as follows:

\[
\text{Percentage} = \frac{\sum \text{the answer} \times \text{score each options}}{n \times \text{highest score}} \times 100\% \quad (1)
\]

It is at a very decent qualifying, but the media still has shortcomings that need to be revised. The revision process was carried out by considering comments and suggestions given by media experts. Comments from Technology Information expert is the display quality is quite good, simple but has a concept, not too confusing. It’s just that the background selection with the desired display needs to be added to a transparent membrane to make it look clear. Comments from Mathematics education expert is the quality of this learning media display is good and interesting, message or learning has been conveyed well. Comments from Mathematics expert are the material is following the concept of mathematics, and the questions presented are HOTS questions which cannot be answered instantly by 2nd-semester mathematics education students.

3.3.2. Data analysis and results interpretation. Data analyzed in this initial data analysis are pre-test value data. This analysis was conducted to determine whether the two classes that have the same initial capability. In this preliminary analysis normality test samples and the conclusion that the data the ability to think critically student experiment class and control class is derived from normally distributed population, test the homogeneity of the sample and the concluded that the sample group control class equal or homogenous, and the test variance matching and the concluded that the experimental class and the control class have the same variance. The second is the final data analysis. This analysis was conducted to test the research hypothesis. After being analyzed, the data are normal and homogeneous.

| Mean | N  | Std. Deviation | Std. Error Mean |
|------|----|----------------|-----------------|
| 8,191| 47 | 1.0711         | 1.562           |
| 7,013| 47 | 1.1776         | 1.718           |

Paired samples test showed that value of \( t = 4.923 \) more than \( \text{Sig.} \ 0.000 \) (2-tailed), it means that the experiment classes are better than the control class. Table 2 showed that a mean of 7.013 was obtained for the control class and 8.191 for the experimental class. This shows that the learning outcomes of the experimental class students are better than the control class.
3.4. Discussion
This research is a research and development study that will produce a product. The product produced in this research is a mathematics learning media in opportunity theory courses in the form of APKs whose implementation is to improve the average mathematical critical thinking ability of prospective mathematics teacher candidates. This study uses the ADDIE development model, namely, analysis, design, development, implementation, and evaluation. In the analysis and design stage, many researchers use the inspiration of learning media that already exists in the play store, then modified by adding the feature “join” that made the difference with instructional media that already exists. Another advantage is almost the same as the learning media in general: can be learned anywhere, can be installed on the Android operating system device, can find references so that the internet is connected, it’s just that there is still no task collection menu which can later be added to the application development in subsequent research.

The APK implementation in probability theory course for the 2019/2020 school year was carried out from February to March 2020 which showed the results that the class given learning using APK achieved the average value of critical thinking skills better than the class where learning did not use the APK even though both classes the average is equally good. This is consistent with similar studies using Android applications on students’ critical thinking skills [24] on student learning outcomes in the form of understanding mathematical concepts [25][26][27].

Teaching Applications
Axiomatic Definition
Suppose:
S is the sample space of an experiment
A is a class of all events, and
P is a really valuable function that is defined in A with an interval codomain [0,1],
then:
P is a probability function and P (A) is a chance of occurrence of event A,
if fulfilled:
(A.1) P(A) ≥ 0, for each A ∈ A
(A.2) P(S) = 1
(A.3) if A_1, A_2, … are a sequence of mutually alien events with A_i ∈ A
( which, A_i ∩ A_j = ∅ for i ≠ j and i, j = 1, 2, 3, …)
and A_1 ∪ A_2 ∪ … = ∪_{i=1}^{∞} A_i ∈ A,
then: \[ P\left(\bigcup_{i=1}^{∞} A_i\right) = \sum_{i=1}^{∞} P(A_i) \]

4. Conclusion
The conclusion of this research is that: The APK design to improve critical thinking skills is made by characterizing the mathematics and campus teacher specialties at the Universitas PGRI Semarang with several additional features that are not yet available in many other similar media, namely the join and search features; Based on testing of media experts and subject matter experts showed that the design and the device APK is a medium of learning that is worthy of use by ma student. Based on the results of the study, classes are given learning using APK to achieve an average value of critical thinking skills better than classes where learning does not use APK even though both classes are equally good.
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