Improved Learning Outcomes of Descriptive Statistics Through the Test Room and Data Processing Features in the Mobile Learning Model

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***Abstract*— Descriptive statistics plays an important role in processing and presenting data. Therefore descriptive statistics is one of the topics that must be mastered by all students, including Informatics Engineering students. Unfortunately, the high mathematical content in this topic is often considered as a threat to students. It makes them get bored and distracted their attention to other things, mostly to their smartphones. This study conducted to develop a mobile-based descriptive statistical learning media that facilitate student work feedback. The feedback was given through the Test Room and Data Processing Features. The media was developed using the prototyping method. The analysis is done by conducting interviews, distributing questionnaires, and trying similar applications. Verification is done using the black-box testing method, which provides input and sees the output. Validation is done by analyzing the results of examinations from two groups of students, the treated group and the control group. The validation results show that the learning outcome from the treated group was improved. The percentage of students who experienced an increase in exam scores from the treated group was 144% greater than the control group.**

Keywords—descriptive statistics, mobile learning model, learning outcome Introduction (Heading 1)

I. INTRODUCTION

Descriptive statistics is a part of statistics that provides a variety of data processing and presentation techniques so that it becomes more informative. The use of descriptive statistics as a tool for processing and presenting data has been done by researchers from various fields of science. Jeenanunta, et al. used descriptive statistics to help analyze internal and external factors that have an impact on innovation in the Thai manufacturing and service industries [1]. Hans-Jürgen Zepernick and Thi My Chinh Chu used descriptive statistics analysis of subjective experiments in mobile imaging [2]. Descriptive statistics are also widely used in education to measure learning outcomes [3, 4, 5, 6, 7, 8].

Descriptive statistics plays an important role in processing and presenting data. Therefore, descriptive statistics is one of the topics that must be mastered by all students, including Informatics Engineering students of a leading private university in East Java. However, descriptive statistics material that contains a lot of mathematics makes this material often feared by students [9]. Exam results for the last 3 semesters in the Informatics Engineering program of University 'X' show that the average test scores are not good and tend to fall (Table 1). The number of students who score below 55 is still above 25% (on a scale 0 – 100, 55 is the lower limit for students to get a grade of C). The teaching and learning process at this time is still dominated by the learning process in class so students get bored easily and their attention is easily diverted to other things. As a result, the material submitted was not well received. Strengthening the understanding that should be done independently is not much done because students have difficulty getting feedback about the results of independent learning. This was confirmed by research conducted by Rahma on descriptive statistics learning in the Syariah Economics program. In her research, Rahma explained that one of the main causes of low student test scores was the lack of feedback on the results of the exam so that students did not know their mistakes and had no opportunity to correct them [10]. The same problem is experienced by other researchers in the teaching and learning process [8, 11, 12, 13].

One way to improved student learning outcomes is to apply effective and fun learning models [6]. The use of appropriate learning media in the teaching and learning process can encourage positive changes in one's knowledge and behavior [6, 9, 14, 15, 16, 17, 18]. Descriptive Statistics learning multimedia developed by Baso Ali and Bobby Poerwanto succeeded in increasing the motivation and learning outcomes of the University of Cokroaminoto Palopo (UNCP) Informatics Engineering students [8]. Learning media in the form of videos has been proven to increase the interest in learning Natural Sciences of Third Grade Students of Inpres Lanraki 2 Elementary School, Tamalanrea District, Makassar [6]. The used of Multimedia Computer Assisted Language Learning (MCALL) could improve the learners 'listening skills on Iranian EFL

Learners' L2 Listening Comprehension [15]. Learning media in the form of comics seem to increase student achievement in statistical learning [9]. There are still many other studies that showed the use of appropriate learning media in teaching and learning can increase student motivation and learning outcomes.

Very rapid technological developments add to the function of a tablet or smartphone to expand the learning environment in order to overcome the limitations of time and traditional learning space [12]. The existence of tablets or smartphones is also familiar to students [11]. Research conducted by Ika Lestari and Gusti Yarmi showed that all students who were respondents in the study used cellphones and some even had more than one cell phone [19]. Asep Irpan Nugraha's research showed that 24.6% of students use smartphones for learning activities [20], while Ika Lestari and Gusti Yarmi's research showed that at least 50% of students use mobile phones for learning purposes [19].

TABLE I. DESCRIPTIVE STATISTICS TEST RESULTS IN THE INFORMATICS ENGINEERING PROGRAM, UNIVERSITY 'X'

	Academic Year		
	2017-2018	***2018-2019***	***2019-2020***
Number of Students	92	128	76
Students with a score of less than 55	34 (36.96%)	34 (26.56%)	37 (46.68%)
Mean standard deviation	57 18.2	56 15.5	53 26.7

Various learning media using computers and/or smartphones are proven to increase motivation or student learning outcomes. However, various learning media that have been developed have not been able to provide feedback on data entered independently. The research conducted developed a mobile-based descriptive statistics learning media that facilitates student work feedback. The learning media developed provides a test room feature, where students can input data independently and will automatically get feedback in the form of processing steps and/or presentation of the inputted data.

The study was developed using the prototyping method. The workflow of the prototyping method can be seen in Figure 1. The analysis was done by conducting interviews, distributing questionnaires, and trying similar applications. The interview was conducted in a semi-structured manner with two statistics lecturers in the Informatics Engineering program, University 'X'. The first lecturer has a background in Informatics Engineering and the second lecturer is a mathematician. The questionnaire was distributed using the cluster sampling method. Samples are selected from students who have taken statistics courses. The number of respondents who responded to the questionnaire was 42 students. Similar applications analyzed were "Descriptive Statistics" by Neteru Studio and the website "Quipper" by PT Quipper Edukasi Indonesia. The results of the analysis are used to design and build prototypes. The complete prototype was consulted with 2 statistics lecturers and evaluated by 16 students who were taking statistics courses. Input obtained from respondents is used to improve the prototype. The final prototype is used to build applications. The application was developed using framework 7. To ensure that the application built is running as it should and could help improve student motivation and learning outcomes, verification, and validation are carried out. Verification is done using the black-box testing method, which provides input and sees the output. Validation is done by analyzing the results of examinations from two groups of students participating in statistics courses, the treated group, and the control group. Each group consists of 16 students. In the first stage, the learning process is carried out in all groups without using any application. At the end of the first stage, all students were asked to take the same exam questions. In the second stage, the two groups were asked to relearn descriptive statistics material, the first group used the application to be tested, while the second group was without application. After that, the two groups were asked to work on the same problem but different from the questions in the first stage.

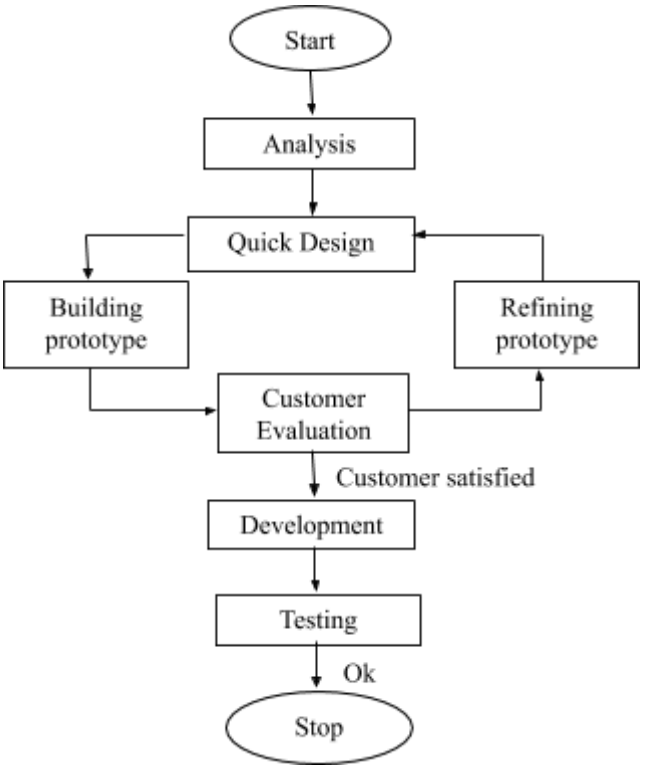

Fig. 1. Prototyping Method Flow Diagram

II. RESULTS AND DISCUSSIONS

Based on interviews with lecturers it was found that students get bored easily and their attention is easily diverted to other things. This kind of situation is found when the number of students participating in statistics courses is very large, around 90 students. A large number of participants and the limited teaching time in the class resulted in the teacher limiting student time in working on the practice questions. Whereas the results of the

questionnaire to the participants in the statistics course show that:

- only 17% of respondents received an A (81-100) and 19% of respondents did not pass the statistics course (got a score of less than 55),
- 26% of respondents were reluctant to listen to lecturers' explanations in class, so they most likely did not have lecture notes,
- 79% of respondents who encountered difficulties when studying would ask friends, lecturers, or try to find their own solutions via the internet. The positive side of this data showed that there are still many students who want to learn. The obstacle that was often encountered when students want to ask a friend or lecturer is to adjust the schedule. As a result, many students were reluctant to study independently because they found it difficult to get feedback. Students also still found it difficult to learn through the internet because in general, they were looking for answers to questions that were exactly the same as the practice questions given by lecturers in class.
- 74% of respondents studied just before the test
- 33% of respondents who have used learning applications stated that the material discussed in the application was too simple and incomplete, other than that the user interface was boring.
  The material provided in the "Descriptive Statistics" application is not accompanied by step by step problem solving using the formula provided so the user must look for additional references. In the "Descriptive Statistics" application users could practice with their own problems, but the solution given is not accompanied by a detailed explanation that often confuses the user. The "Quipper" application allowed users to create learning schedules, mark material, add notes to the material but did not allow for input questions themselves, and this application was not free or paid.

The results of the analysis are used as a basis for building prototypes before being implemented in an application form. Interface flow diagrams of the application built can be seen in Figure 2. The main features provided in the application include Material, Practice Questions, Test Room, and Data Processing. The material is presented interactively with detailed step by step so users can play an active role. This method is expected to make the user not easily bored and can follow the explanation well, see Figure 3. At the end of each material, an example is provided with a step-by-step solution. The data used in the example is generated randomly or can be replaced by input by the user. The Practice Questions feature can be used by users to measure a certain level of material mastery. Practice questions are taken randomly from the question bank and the data used on these questions are also generated randomly. This is done so that each time the user practices, the user will get a different problem so the user does not just memorize the answers or get bored quickly. At the end of the exercise, feedback will be given so that the user can find out where the mistakes he/she might have made. The Test Room feature is almost the same as the Practice Question feature. The only difference is in the Test Room feature, users can set the time and number of questions they want to work on. The purpose of this feature is as a test simulation in accordance with the actual exam conditions. It is hoped that after practicing using this feature the user will be better prepared mentally to face the real test. The Data Processing feature is provided so that users can process their own data. The feedback provided on this feature is in the form of a detailed step by step way of processing the data. Feedback from this feature is expected to motivate students to practice independently.

The validation results showed that the percentage of students who experienced an increase in exam scores from the first group (the treated group) was 144% greater than the second group (the control group). On the other hand, the percentage of students who experienced a decline in exam scores from the first group was 50% less than the second group. Details of the validation results can be seen in Table 2. Evaluation of the validation results showed that the application was able to improve the learning outcomes of respondents. Further analysis showed that each feature provided in the application was useful to help the learning process of at least 66.67% of respondents in the first group even though the majority of them use the application less than three times a week.

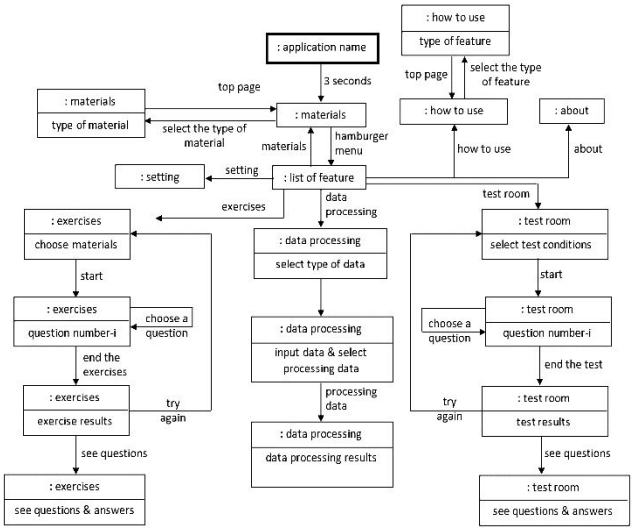

Fig. 2. Interface Flow Diagram

TABLE II. VALIDATION RESULTS

Group	Comparison of Stage 1 and Stage 2 Test Results			
	Decrease	*Equal*	*Increase*	*Total*
Treated	18.75%	0%	81.25%	100%
Control	37.5%	6.25%	56.25%	100%

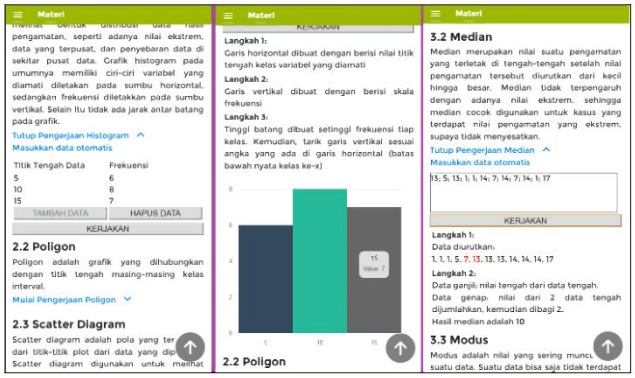

Fig. 3. Application Interface

III. Conclusion

This application was built to overcome the problems that occur when descriptive statistics are given to large classes where the number of students is around 90 people. Lack of feedback was one of the obstacles for students to learn independently. The validation results showed that the application can improve student learning outcomes. 81.25% of students in the treatment group experienced an increase in test scores. This percentage was 144% higher than the number of students from the control group who experienced the same thing. All features in the application, including the test room and data-processing features that provide feedback to the users, were felt to be useful in helping the learning process. This application can be developed by adding an animation effect to the step-by-step explanation of problem-solving to increase student motivation.

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