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Android-based applications on teaching skills based on TPACK analysis

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Abstract. Teaching skills learned in micro-teaching are important competencies in the learning management. Dependence of other parties, both lecturers and colleagues teaching during the assessment process of teaching practice and lack of media that integrates the concept of material, examples, and practices are obstacles in mastering teaching skills. This article describes the specifications needed of an Android-based learning tool (media) for microteaching ("Microteaching") courses and analyzes the performance of these learning media. The development phase begins with Analysis, Design, Development, and Evaluation. The results of the analysis referring to TPACK and the design showed that the specifications of the Android-based media consisted of two main menus namely material (containing various multimedia elements) and assessment (besides text-based assessment also contained speech recognition elements). The performance of "Microteaching" in functionality is 100% successful, while the feasibility test at the evaluation stage not only for media experts, but material experts and users indicates that the media is suitable for use. Furthermore, results of the assessment show that the media is able to depend on the assessment, except from the aspect of verbal aspects. Integration of learning concept material through mind maps, technical examples related to verbal teaching skills and videos to provide concrete description of how to teach (both verbal and non-verbal).

1. Introduction

In the education study program, micro teaching is a course that must be followed by students to get information and experience in ways to teach technically in the classroom. Micro-teaching is an early stage training in the formation of teaching competencies for prospective teacher [1]. Micro-Teaching is a course that has a very important role to equip prospective teacher with teaching skills[2]. To learn teaching skills, the teacher training techniques is microteaching[3]. Especially, it is a technique to train the prospective teachers[4]. Micro-teaching is a powerful way in teacher training to improve the instructional experience of prospective teachers and has been adopted in a number of teacher education institutions that are committed to producing qualified future teacher candidates[5]. In a limited time, especially students of technical education study program get teaching experience in front of the class to apply pedagogical theory and engineering practice. Next, through the teaching practice program at school, students can implement the teaching skills learned in micro-teaching courses. Micro-teaching is an efficient technique that has a positive impact on the competence of teaching students when the student practices teaching in a real class (school)[5]. Mastery of teaching skills is important to be achieved before the implementation of teaching practice in schools. Therefore, micro-teaching learning plays an important role in preparing future teachers, especially in preparing mastery of teaching skills.

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One of the implications of the successful achievement of micro-teaching learning outcomes in education study programs is through successful teaching practices in schools. In the period of teaching practice in schools from 2015 to 2017 at one of Vocational High School in Yogyakarta, some aspects of teaching skills owned by students are still lacking or even not appearing and there are indications that students are not confident when teaching in class[6]. The interviews showed several things, namely: (1) aspects of teaching skills that were rated at least were classroom management skills; (2) skills in conducting learning variations are also considered lacking which is indicated by the frequent giving of written assignments to students (there is no variation in student activity); (3) skills to teach small groups and individuals are still lacking which is indicated by the lack of clarity in the delivery of the objectives of group learning activities, the lack of a positive response and often the students sit in the teacher's seat (not approaching and guiding); (4) do not pay attention to aspects of teaching skills on lesson plans; and (5) self-distrust indicated by the implementation of teaching practices that always invite other students in the class[6]. Especially the findings of the fact that there are students who are not confident are contrary to the results of research that show that micro-teaching is able to increase self-awareness and confidence, and also supports the discovery of teaching styles for students[7]. The findings of students' unpreparedness in the practice of teaching in school indicate problems in micro-teaching learning.

Based on the lesson plan at Micro Learning in the Faculty of Engineering, Yogyakarta State University shows that from 16 meetings, ten teaching practices were held, namely one limited teaching skills practice meeting, three meetings of integrated skills in theoretical subjects, three meetings of integrated skills practice subjects in the laboratory, and three meetings on the practice of integrated skills in practical subjects in the workshop[8]. Interviews with lecturers showed the conclusion that the assessment of one aspect of students' teaching skills in one class took 2 meetings and students could practice teaching class 6 times. In addition, from the 6 times the practice, students did not fully practice the overall teaching skills and some teaching skills were not trained repeatedly or only one practice. Teaching skills require habituation, so the number of repetition exercises can be a factor that determines the flexibility of teaching.

Other findings on micro-teaching learning in the classroom are media on teaching skills material in the form of mastery of concepts, examples and direct practices for students that are integrated and easily accessible for students not yet realized. The deepening of material and teaching skills practices for students is very dependent on face-to-face learning in class. One of the obstacles in micro-learning is the dependence of the role of lecturers as assessors of student teaching skills. Therefore, it is necessary to make efforts to reduce the dependence of the assessment through the use of technology in learning. In 21st century learning, educators must implement technology and media to help students master 21st-century skills[9]. In addition, pre-service teachers need significant practice working with various technological tools as part of their teacher- education program[10]. One technology that can be utilized is a mobile application, a software system that functions on a mobile device[11]. When used in learning, it can be termed a mobile learning application that is a form of learning on mobile telecommunications devices with mobile networks. Benefits that can be taken from the use of mobile learning applications include: (1) rapid communication; (2) portable and easy to use; (3) provide opportunities to access learning at any time and anywhere; (4) learning material can be remembered more by users because it is learned according to the user's learning desires; (5) facilitate user interactivity; (6) costs that tend to be cheaper because there are generally users already have a mobile device[12]; (7) having more privacy[13]; and (8) more flexible assessment[14]. One device that supports mobile learning is a smartphone.

Smartphone users in 2014 are 1.57 billion and continue to increase every year until predicted in 2020, smartphone users totaling 2.87 billion[15]. Students are one component of smartphone users. Current students include generation Z, the generation born after the birth of the internet. In Indonesia, generation Z is a generation born in 1995 and thereafter[16]. Generation Z has better access to Information and Communication Technology (ICT) than the previous generation[17]. This fact is the basis for the importance of developing learning media that can be used on smartphones. Observation in class shows that all students have a smartphone, so the development of media on smartphones is considered easily

accessible to students. There are many operating systems that control smartphones. Android is an operating system that gets the highest sales value compared to other operating systems [18]. Some of the things that cause Android to be selected include speed factors, productivity aspects, user-friendly design creativity, flexibility and reliability [19] and because Android is a complete, open source and unpaid platform[20]. This is the basis of consideration for the development of developing learning media on smartphones using the Android operating system. One developer in developing an Android application is Android Studio. The selection of the developer is based on the official Android programming IDE from Google and has features that are easily developed by developers.

The application of the Android application as a learning media must fulfill the elements of learning media. The elements of the learning media in question include: (1) aiming to convey messages; (2) the achievement of learning objectives; (3) there is a match between the characteristics of the media and the characteristics of the subject matter presented; (4) adjusted to the form of learning activities[21]; (5) clarifying information (understanding concepts); (6) facilitate and improve learning processes and outcomes; (7) raises learning motivation; (8) direct interactivity by users according to their abilities and interests; (9) overcoming the limitations of the senses, space and time; (10) giving students the same experience[22]; (11) meet the elements of suitability or relevance, ease, attractiveness and usefulness[23]. The usability element is the most important thing in the development of mobile learning application[24] because supporting the application becomes easy to use (easy to use), increases productivity, reduces training costs, and increases user satisfaction (5), and can ensure that interaction design and Interface design is well done to support interaction (8). Usability instrument[25] was chosen because the instrument was prepared for mobile applications that have similarities with the applications developed in this study.

In general, the stages of software development consist of analysis, design, development, and evaluation. Pressman[26]stated that the first stage of software development needs to do Software Requirements Analysis. Regarding the use of technology in learning, the analysis is carried out through Technological Pedagogical Content and Knowledge (TPACK). TPACK is a technology integration framework that identifies three types of needs that need to be combined in teaching namely technology, pedagogy and knowledge material[27]. At TPACK, technology must not master learning, but technology needs to be combined with pedagogy and knowledge material. Software Requirements Analysis is done to get application specifications. Up to this stage, the analysis phase is completed and continued with the design stages. The focus of activities carried out at the design stage is data design, architectural design, interface design, and algorithm design. The development stage is a design implementation that is coding and testing errors in the program code that is created. The last stage is an evaluation. The evaluation in question is to review the application which consists of: (1) control structure testing using testing on android developers; (2) black box testing to perform functionality tests; (3) validation of media experts and material experts to conduct a feasibility test to fulfill the elements of learning media; (4) user testing to lecturers and students to conduct usability tests; and (5) product revision (application). Data retrieval uses a questionnaire with five alternative answer choices regarding the media developed. Score conversion is divided into five categories[28], which are very feasible with a score interval X> Mi + 1.8 Sbi (X> 4.2), feasible with Mi score intervals + 0.6 Sbi <X ⩽ Mi + 1.8 Sbi (3 , 4 <X ⩽ 4.2), enough with the Mi score interval - 0.6 Sbi <X ⩽ Mi + 0.6 Sbi (2.6 <X 4 3.4), less than the Mi-1 score interval, 8 Sbi <X ⩽ Mi - 0.6 Sbi (1.8 <X 6 2.6), and not feasible with a score interval X ⩽ Mi - 1.8 Sbi (X ⩽ 1.8).

2. Android-based applications on basic teaching skills based on TPACK analysis

The analysis starts from defining the phenomena that occur, namely the unpreparedness of students of education study programs while practicing teaching at the school. Signs that arise are the lack of mastery of teaching skills. On the other hand, teaching skills are learned by students in micro-teaching courses. This indicates a problem in micro-teaching learning. The lack of teaching practice training and the lack

of media that integrate material (concepts, examples) and assessment are the causes of problems in micro-learning, especially in the Faculty of Engineering, UNY. Teaching aid development in micro-teaching learning is needed to overcome this. The novelty to be conveyed in this paper is the use of TPACK as a method of analyzing media development. The use of technology in micro-teaching requires TPACK analysis first[29]. The TPACK analysis was carried out to obtain teaching aid in accordance with the needs of micro-teaching learning. Table 1 shows the results of the TPACK analysis performed.

Table 1. The results of the TPACK analysis

Analysis	Result
Technological Knowledge (TK)	The application of mobile learning applications on Android studio-based smartphones contains learning multimedia (text, audio, visual, involving more than two senses)
Pedagogical knowledge (PK)	a. learning tutorial for mastering the concept of material (text, mind map, image audio, video) b. assessment of concept understanding c. repetitive teaching practice (habituation).
Content knowledge (CK)	Concepts and examples of teaching skills according to the lesson plan
Pedagogical content knowledge (PCK)	a. Giving tutorial material (text, mind map, audio, video) about concepts and examples of teaching skills b. Assessment of concepts and examples of teaching skills c. Practice teaching skills
Technological content knowledge (TCK)	The use of Android-based applications with material features (text, image, audio, video), chatbot, questions, practice teaching skills and notification of training progress.
Technological pedagogical knowledge (TPK)	The use of Android-based applications with material features (text, image, audio, video), chatbot, questions, practice teaching skills and notification of progress of training through the application of hybrid models (tutorials and drills), multiple choice tests understanding concepts and exercises and assessments practice teaching skills repeatedly
TPACK	Android-based applications are used in learning with material features (text, image, audio, video), chatbot, questions, practice teaching skills and training progress notification through the application of hybrid models (tutorials and drills) for understanding the concept of microteaching material assessed through tests multiple choice and repeated practice and assessment of teaching skills

From the TPACK analysis, it is known that to overcome problems in the form of a lack of a number of repetition of teaching skills by developing teaching practice assessment features that can be done by users anytime and anywhere. The concept of mastery of the concept is comprehensively overcome by the features of the material that presents multimedia (text, mind map, audio image, video) and the assessment of material concepts. Features of material and assessment (both concept and practice of repetitive teaching skills) integrated into one tangible media based on Android applications. Mindmap is able to avoid misconceptions. The prospective teachers must avoid misconceptions in advance so that learning competencies can be achieved [30]. In the CK analysis, the material is adjusted to the lesson plan [31], this is because the learning media function to achieve the learning objectives planned for the lesson plan. The integration of technology that has been applied to micro-teaching include: (1) Network Multimedia Technology Reflected in the Microteaching for recording, storage, transmission, regulate

and recurrence[32]; (2) video open class, (3) MOOC[33]; (4) video technology[10], [34]–[36]; and (5) use of ICT technology such as Laptops, LCD projectors, Desktops, EDUCOM, Smart classes, Memory sticks to find material sources[37]. The other novelty in this paper is the strategy of using smartphones as a teaching aid platform for micro-teaching. The smartphone usage strategy in question can be seen in the Table 2.

Table 2. Smartphone Strategies and Contributions

Strategies (features)	Contribution
Content material	mastery of concepts, especially with the presence of mind maps, examples of teaching skills and teaching practice videos
Questions	assessment of the results of mastering the concept
Chatbot	mastery of concepts through strategies to explore the ability to ask questions
Verbal teaching skills practice	practice verbal skills in repetitive teaching skills
Progress	to monitor the learning activities that have been done by users on the application
Notification	to notify users about learning activities that need to be done

The results of TPACK's analysis and strategy features on the smartphone are used to determine the specifications of the device needs. Product specifications developed are Android-based applications that are able to provide interactive material, display interactive dialogs or chats between users and bots, test verbal skills through recorded oral tests and display progress. Hardware requirements include (1) Android with a Lollipop operating system; (2) i5 processor specification laptop with 4GB RAM; and (3) Device specifications for 2GB RAM and Lollipop operating system. Software Requirements are (1) Android Studio with version 3.0.1; and (2) Android SDK with API 26. Functional requirements for applications that are capable of displaying: (1) splash screen; (2) showcase; (3) messaging display; (4) expenses when users enter the word; (5) material that functions as keyword messaging; (6) the progress of user value; and (7) license and credit menus. Menu needs consisting of: (1) Material containing a collection of materials related to microteaching concepts presented in the form of text, audio and video; (2) Problem Training containing questions that can be done to test knowledge about concepts that have been learned related to microteaching; (3) Conversation (chatbot), where users can have conversations with bots to deepen aspects and items of teaching skills; and (4) the practice of teaching skills (verbal ability - speech recognition) to test the user's verbal skills through the user's oral pronunciation related to eight teaching skills. The work system of the application can be shown in Figure 1.

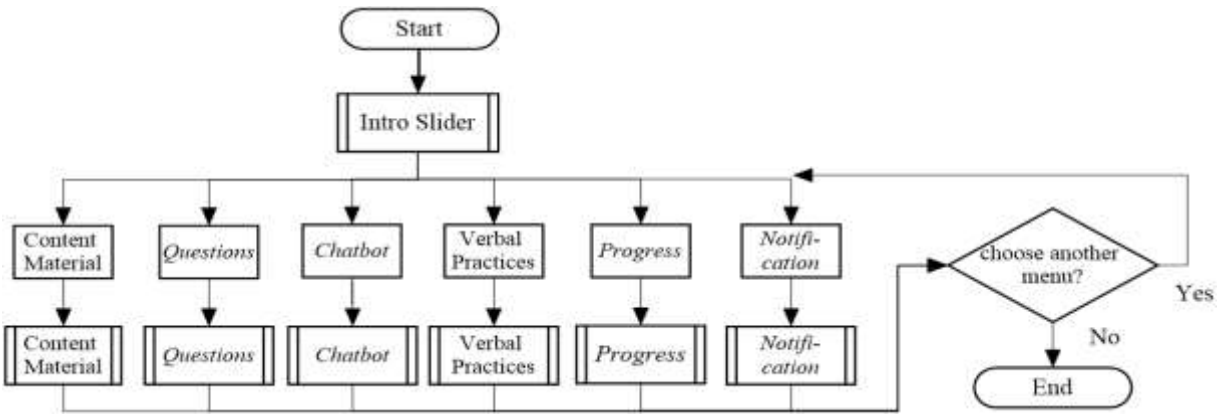


Figure 1. Application flowchart

When the application is first to run, there is an intro feature that displays the features that are in the application briefly. Furthermore, users can make menu selections as desired. Users can choose other menus after opening a menu. Videos on material features are made based on storyboards that refer to the assessment sheet on aspects of teaching skills. There are 9 videos consisting of teaching skills, namely, namely: (1a) learning opening skills; (1b) skills to close learning, (2) skills to explain; (3) questioning skills; (4) skills to make variations; (5) skills to provide reinforcement; (6) class management skills; (7) teaching skills for small groups and individuals; and (8) skills in leading small group discussions. Design results in the form of data design, architectural design, interface design, and algorithm design. The development stage consists of coding and testing errors in the program code created. The evaluation phase includes three things, namely control structure testing, functionality testing, and usability testing. The evaluation phase in the form of control structure testing uses testing on android developers, where all get the comments "process finished with exit code 0". Figure 2 shows an example of the results of the unit test in the progress and notification feature, where the top left of the test results progress feature, the bottom left of the notification feature testing feature, and the right part shows the progress and notification display features.

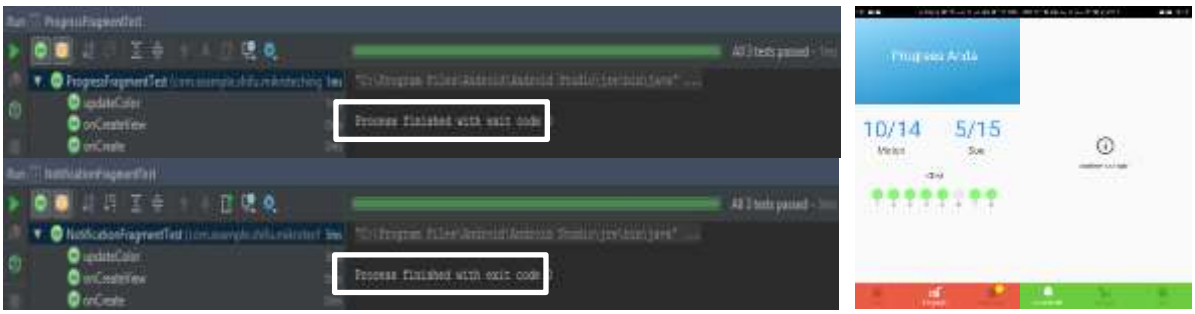


Figure 2. Example Unit Test Results (progress and notification features)

The evaluation phase in the form of black box testing to perform functionality tests shows that 100% of the devices have successfully shown the targeted function. There is a suggestion from the expert who performs the functionality test that is to add navigation "back" or return to the test menu (work on the question) and need to add the question number to the test menu. Both of these suggestions are followed up by adding back navigation and giving a test number. Media expert validation was done by two media experts. This validation was used to test the feasibility of fulfilling the elements of learning media. The result of the score is 3.79 which shows that from the media aspect, then “Microteaching” is suitable to be used as a learning medium. Validation of material experts is done to two material experts. The result of the 4.07 score shows that from the material aspect, “Microteaching” contains appropriate material regarding aspects of teaching skills. Test users to lecturers and students to conduct usability tests. The result of the acquisition is 3.91 which shows that from “Microteaching” is worthy of use. Figure 3 shows that all aspects of each evaluation show a score above 3.4 with "decent" interpretation. For aspects of benefit in the evaluation of material experts and technical aspects in the evaluation of media experts show very decent. The assessment results show that the material aspects of the media are in accordance with the lesson plan and technically, the media is easy to use. Even though the media received a proper assessment from each evaluation, the development team continued to make improvements based on the

input obtained from the media assessment. From various improvement suggestions, Table 2 shows some improvements that have been made. Some display results from the Android application developed in this study can be seen in Figure 4.

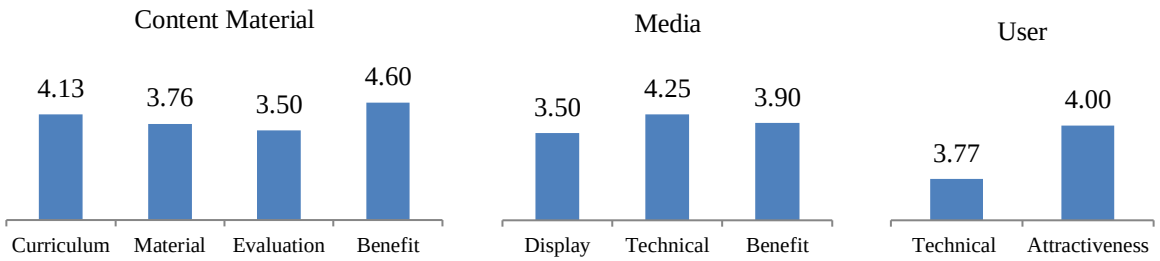


Figure 3. Test results of media experts, material experts, and users

Table 3. Revisions

No.	Suggestions for improvement	Results
1.	The icon is not clear	Change the main menu icon to make it clearer
2.	The material menu needs to be made more interesting	Add images and mind maps to the material to make it interesting.
3.	On the test menu, users cannot return to the previous question.	Add a reminder to avoid mistakes in selecting answers.
4.	In working on the test questions, given the number of the questions and the number of questions.	Add information about the problem number and number of questions.
5.	Some illustrations are given for each material to make it more interesting and not monotonous.	Add illustrations to the material



Figure 4. Some display results from the Android application developed in this study (intro, features, content material, questions, chatbot, verbal practices)

Application functionality and assessment of feasibility in each aspect of evaluation that is considered feasible, indicating the media can be used in learning. Because of that, "Microteaching" fulfills the elements of learning media, among others, the message to be transferred to students can be conveyed well, learning objectives can be achieved, helping students in understanding the concept of material, improving and improving learning processes and outcomes, and increasing student motivation in learning. The advantage of the application developed is the existence of mind maps to support the

mastery of concepts and the existence of examples of teaching practices in the form of videos. The video is easier for students to get concrete examples of teaching practice. The chatbot feature is a new method offered by the team to accommodate and stimulate students' questioning skills. Efforts to improve skills, especially the ability to ask questions for prospective teacher students are needed[38]. The results of the needs analysis that cannot be implemented in this application are that the chatbot feature is still not comprehensive and still limited to displaying the material and the teaching skill practices feature is still limited to the practice of speaking, without assessing good teaching gesture. For further research, it is expected to be able to add material and interactivity to the chatbot feature, while the teaching skill practices feature adds a gesture assessment feature to teaching skills especially for non-verbal assessment, it needs to be developed to be able to assess non-verbal ability (gesture) by utilizing the development of computer vision (gesture recognition) and affective computing while still integrating the smartphone platform to facilitate users.

3. Conclusion

Technological involvement in learning activities cannot be avoided, technology integration in micro-teaching is one of the efforts to face these challenges. From various tests and revisions, the results show that: (1) the android-based application is used in learning with the bank features of the question bank, chatbot, audio interaction through the application of hybrid models (tutorials and drills) for understanding the concept of general microteaching material assessed through tests multiple choice and repeated training and assessment of teaching skills practices with menu display (a) demo; b) material bank; (c) chatbot; (d) multiple choice tests; (e) teaching skill practices; (f) progress; (g) notifications and licensing and credit menus; and (2) evaluation results show that control structure testing using testing on android developers shows that all codes have been tested by the unit and indicate that the code has passed all tests and there is no error in the code; (2) test functionality worth 100% indicates that the application can be run without any constraints; (3) the validation of media experts is 3.79 and the material expert is 4.07, both of which indicate that they are suitable to be used, so that the "Microteaching" application can be said to have fulfilled the elements of the learning media; (4) test the user to do usability test with a value of 3.91 indicating that the "Microteaching" application is technically easy and interesting to use; and (5) product revisions (applications) have been carried out. There are limitations in this case the chat feature is still not much and is still limited to displaying material. Nevertheless, the application has the advantage of having complete material accompanied by mind maps and videos. The results of the development of this application, are considered capable of realizing a media that integrates material concepts, examples and limited practices.

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