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## Developing Mobile Learning Application Containing Basic Pedagogy Material as the Supplement in Improving College Students' Learning Outcome in Teacher Training Institutes of Indonesia

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**Abstract:** The vast technological development affects every layer of people's daily life, including Education. However, Indonesia's tertiary education status quo has not exhibited any rapid development in information technology-based learning media. This study aimed to develop and identify the effectiveness of Basic Pedagogy Material online learning material in improving students' outcomes in pedagogy. It applied R & D design with a waterfall development model on second-semester students in Universitas Negeri Semarang, Indonesia, during the educational year of 2020/2021. The data collected through interviews, observation, questionnaire, scale, and test were analyzed using independent t-test and n-gain. The findings indicated a significant difference between the average score before and after students used the Basic Pedagogy Materials mobile learning application during the learning process. Therefore, the mobile learning application developed effectively improves students' learning outcomes in pedagogy subjects effectively.

**Keywords:** *Learning outcomes, material pedagogy, mobile learning.*

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### Introduction

Education aims at helping learners achieve optimum development according to their potential, abilities, and values (Letina, 2020). An optimal self-potential could be identified from high academic achievement (Khan et al., 2013). In this regard, high academic achievement has become an educational indicator of students' competence in mastering the learning material. It could be accomplished through the support of learning innovation and media, and teaching methods (Cimermanová, 2018; Salmon, 2015; Surjanti et al., 2018).

The initial observation showed that the issue often faced by students in learning is the lack of enthusiasm in following the lecture. This is because lecturers apply teacher- learning methods without involving the students (Trimurtini et al., 2020).

The questionnaire results showed that 65% of students find the lectures boring. Students that ought to be the center of learning are passively involved in the learning process. Additionally, Sudarman and Sugeng (2017) found that around 50% of lecturers demand more developed information and communication technology-based learning media to support teaching and learning. This implies a mutual demand from students and lecturers for innovations in learning. Conventional learning should be transformed to become information and communication technology-based. According to Chuang (2014), utilizing technology as learning media would elevate students' motivation. High learning motivation

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positively influences the learning outcome (Riswanto & Aryani, 2017). Students with high motivation in learning have higher chances of obtaining high academic achievement.

Efficient technological development is becoming the main focus of Education (Ratheeswari, 2018). Subsequently, a nation would develop and move forward as the number one nation in the world (Gholami et al., 2010). Rafi (2018) stated that information and communication technology development is considered a booming topic when connected to a country's economic development. The vast advancement of technology would affect every layer of life, including education. Technological progress positively impacts Education by providing convenience in delivering teaching materials to students (Ahmadi et al., 2020).

Education is one of the many fields affected by the application of information technology in its development. The development of information technology-based learning media has also significantly improved by the development of information technology (Valverde-Berrocoso et al., 2020). Various alternatives to learning media have been developed by many information technologists and academicians. However, the status quo in Higher Education has not progressed in terms of interesting innovations in IT-based learning media development. Some lecturers are still reluctant to develop learning media due to the workload in their institutions. Furthermore, many lecturers still apply conventional lecturing models in learning (Herman et al., 2014). Such issues particularly occur in some Teacher Training Institutes that conduct education for pre-service teachers in Indonesia. The lecturers do not have many capabilities in developing learning media. Most of them teach stagnantly using the available media. In this era, lecturers should master technology to support teaching and learning (Isroqmi, 2020). Academics are expected to be highly willing to develop interesting media that would help create a fun and non-conventional learning process (Nugroho et al., 2020).

Studies on Basic Pedagogy Materials pedagogy are still rare, and Sullivan (2019) stated that teaching about these materials needs models and learning media that increase students' motivation. Furthermore, Pelman and Zoran (2022) stated with the current technological developments, the delivery of pedagogical materials rely on references from books and internet sources. In line with this, studies develop Basic Pedagogy Materials using mobile learning technology applications. Furthermore, based on empirical studies from several previous studies, Basic Pedagogy Materials emphasize learning that provides students with a comprehensive understanding of what and how it should be and educational facts. which is in line with the cultural foundation of the Indonesian nation (Rachmadtullah et al., 2018). Whereas, Jiang et al. (2022) so far teaching in the Basic Pedagogy Materials course is delivering messages through the lecture learning method and has teaching materials as a reference for students to explore information, but technology-based learning media on Basic Pedagogy Materials is still rarely developed, even though this is important because with The existence of Basic Pedagogy Materials learning media makes it easier for lecturers to convey messages about learning materials and the advantages of learning materials the development of Basic Pedagogy Materials, namely the material presented is more focused on the process that highlights the relationship between education, teaching, and learning that aims to develop the personality of students as prospective teachers, the development of Basic Pedagogy Materials is also beneficial to students because they can understand Pedagogy as a science that underlies the think and act in the context of the implementation of education.

As many multimedia learning media are being developed, this study also aimed to develop a new android-based mobile learning technology. Sönmez et al. (2018) stated that mobile learning offers students flexibility regarding time and place. This technology also provides educational content to help students achieve the targeted knowledge without being limited by location and time (Viberg, 2015). According to Ally and Prieto-Blázquez (2014), mobile learning also has several advantages in terms of flexibility in time and place. The learning process could be conducted actively as the students become the center of learning and teachers only act as facilitators.

Maher (2004) defined learning outcome as the measurement to ensure the quality and efficiency of learning in Higher Education. Aziz et al. (2012) also stated that learning outcomes would portray knowledge and skill development in every subject and provide a structure to evaluate the teaching and learning process. Therefore, the learning outcome is the benchmark of effective learning. Sulasteri et al. (2018) stated that one of the external factors determining learning effectiveness is the learning media.

There are many studies on mobile learning applications, and Sulasteri et al. (2018) stated that the visual media attention function is the core. It directs students' attention to concentrate on related lesson content with a visual meaning accompanying the subject matter. Tafonao (2018) developed media applications for learning in elementary schools. However, research and development of Mobile Learning applications containing Pedagogical Main Materials as Complementary in Improving Student Learning Outcomes at IKIP Indonesia are rare. According to Widyaningrum (2015), mobile learning applications improves student outcomes.

The explanation shows an urgency to develop learning media to improve college students' learning outcomes. Therefore, this study aimed to develop basic pedagogy materials for mobile learning application that improves students' outcome in Teacher Training Institutes. It is expected to help educators in teacher colleges assist students in learning the Basic Pedagogy Materiala.

## Methodology

### *Research Design*

This study aimed to develop basic pedagogy materials mobile learning application that improves students' outcomes in Teacher Training Institutes for Basic Pedagogy Material. The study used a waterfall development design for research and development (R&D). There are five stages in the waterfall development model (Alshamrani & Bahattab, 2015). The stages include: (a) requirements analysis, (b) design, (c) implementation, (d) testing, and (e) maintenance.

In the requirements analysis stage, the data necessary to develop the application were collected and constructed as a required document. The data were collected through interviews, questionnaire distribution, observation, and literary studies using journal articles and an online database. The design stage involved designing the software by constructing reflective questions to avoid bias. The implementation stage aimed to combine the services or components of the produced software through the designing process to develop an organizational framework for expert validation. Moreover, the testing stage entailed improving the performance of the software to ensure that it works efficiently. The testing was conducted by administering a pretest and posttest to the study samples. This aimed to identify the differences in the learning outcome before and after using the developed learning application. The responses from the lecturer and students were collected as a reference for the next learning application development project. The maintenance stage involved revising the software by improving its performance and quality.

### *Respondents*

The research subjects were students and lecturers at the State University of Semarang in the even semester of the 2020/2021 academic year. The sample of this study consisted of 79 students who were divided into four groups taught by seven lecturers. As for the gender of the research sample, 49 were female and 30 were male. The age of the student respondents is 18 years old as many as 30 students. 19 years old totaled 22 students and 20 years old totaled 27 students. as for the characteristics of the respondents in this study were state university students who took Basic Pedagogic Materials. Students who were selected as respondents were given basic concept material to make it easier to follow the developed model. students are also equipped with an understanding of educational science concepts and theories. while seven lecturers are involved in teaching Basic Pedagogic Materials, namely lecturers who have educational backgrounds with educational disciplines

Sampling was carried out by random cluster sampling, assuming the population was normally distributed, homogeneous, and had similar averages. They were divided into group 1 (23 students and one lecturer in BK 1 course), group 2 (24 students and one lecturer in Counseling Guidance course 2), group 3 (11 students and one lecturer in developmental psychology 1), and group 4 (21 students and a lecturer in developmental psychology 2).

### *Data Collection*

Data were collected to assess the feasibility and effectiveness of basic pedagogical materials and mobile learning applications. Data was obtained through observation, interviews, questionnaires, scales, and tests. The instruments used were observation sheets, interview guidelines, and questionnaires to identify the needs of lecturers and students for media development. The feasibility of mobile learning applications for basic pedagogical materials is measured by media and material expert assessment sheets as well as a lecturer and student response questionnaires. The test instrument measures student learning outcomes consisting of pretest and posttest sheets.

In collecting data through observation, researchers made observations about (a) how the process of learning activities in the Basic Pedagogical Materials course was, (b) How many students were active in the learning process, (c) learning resources, and the media used so far. Meanwhile, for interviews, researchers used researchers to interview related lecturers and students about the analysis of any needs to support the process of basic Pedagogical Materials lecture activities. Interview questions included (1) What was the condition of the class during the learning process of Basic Pedagogical Materials, (b) What was the learning method? used by lecturers when lecturing Basic Pedagogical Materials, (c) How do you try to keep the class conducive during learning activities, (d) Do you always consider the validity and relevance of the material when you choose learning materials for students, (e) What are the learning resources that you use in teaching, (f) what learning media have you used so far, (g) what obstacles have you experienced when using the media, (h) are you willing to use the application that I use? create for learning tools and media.

The test instrument was developed with aspects; (a) understanding, (b) ability to analyze, and (c) ability to conclude opinions. The media expert assessment sheet instrument used was made by Sumantri and Rachmadtullah (2016). These aspects and components are shown in Table 1.

*Table 1. Feasibility questionnaire instrument Developing Mobile Learning Applications Containing Basic Pedagogy Materials as Complementary to Student Learning Outcomes at Teacher Training Institutions in Indonesia by expert validation*

Aspect	Component	Evaluation				
		5	4	3	2	1
Display	Layout design					
	Typography					
	Image					
	Animation					
	Audio					
	Video					
Programming	Packaging					
	Usage					
	Navigation <i>Interactive Link</i>					
Total Score						

Source : Sumantri and Rachmadtullah (2016)

For the learning material expert instrument, the Sumantri and Rachmadtullah (2016) instrument was used with aspects of (a) Trueness of media; (b) Degree of importance; (c) Learnability; (d) Attractiveness; (e) Usefulness;

*Table 2. Feasibility Questionnaire Instrument for Mobile Learning Application Development Contains Basic Pedagogical Materials as Complementary to Student Learning Outcomes at Teacher Training Institutions in Indonesia Based on Material Expert Validation*

Aspect	Evaluation				
	5	4	3	2	1
a) Trueness of media					
b) Degree of importance					
c) Learnability					
d) Attractiveness					
e) Usefulness					

Source : Sumantri and Rachmadtullah (2016)

The test instrument is to measure student learning outcomes consisting of pretest and posttest sheets, where students are given test questions by measuring (a) understanding various perspectives on the basic concepts of education, (b) Education as a science, (c) understanding of education as a system. (d) Understanding of the philosophy of education, (e) Understanding of the foundations and principles of education

#### *Characteristics of Basic Pedagogy Materials mobile learning applications*

The Basic Pedagogy Materials mobile learning application can be uploaded via a smartphone by downloading the application on the Playstore if using Android or can be uploaded at <https://rumahilmu.web.id/> in this application learning and learning activities can be carried out because this application provides several platforms such as a collection of learning materials, learning videos, online evaluation tests and virtual communication facilities. The materials included in the Basic Pedagogy Materials mobile learning application are about (a) the educational environment, (b) educational philosophy, (c) the foundations and principles of education. Students have a role in the Basic Pedagogy Materials mobile learning application, namely students can open the application anywhere at any time and are not limited by time, because the Basic Pedagogy Materials mobile learning application can be accessed on the student's smartphone. Students can see directly recorded lecture material and materials that can be studied by students. As for lecturers, they can use the Basic Pedagogy Materials mobile learning application and can develop teaching materials and make it easier for lecturers to share teaching materials easily.

#### *Data Analysis*

This study collected data from the validity test results of media and material experts, as well as responses from lecturers and students. The data were about developing a mobile learning application containing Basic Pedagogy Materials to improve college students' learning outcomes in teacher training institutes in Indonesia. Students' improvement in their learning outcomes before and after the treatment was tested using N-Gain. Independent t-test statistical analysis was also conducted through normality and homogeneity tests. Table 1 presents the normality test results.

Table 3. The Result of the Normality Test of the Research Samples

No	Class	Kolmogorov-Smirnov <sup>a</sup>			
		Data	Statistics	df	p
1.	Class 1	Pretest	0.193	23	.105
		Posttest	0.137	23	.200
2.	Class 2	Pretest	0.194	24	.165
		Posttest	0.199	24	.175
3.	Class 3	Pretest	0.227	11	.117
		Posttest	0.222	11	.135
4.	Class 4	Pretest	0.168	21	.126
		Posttest	0.169	21	.120

The values of p from the pretest and posttest among the four groups are higher than 0.05, meaning the data were normally distributed. Table 3 shows the result of the homogeneity test on the data variation.

Table 4. The Result of the Homogeneity Test on Students' Learning Outcome on Mobile Learning Application Development Contains Basic Pedagogical Materials as Complementary

No	Class	Student Learning Outcomes			
		F	df <sub>1</sub>	df <sub>2</sub>	p
1.	Class 1	0.19	1	44	0.892
2.	Class 2	0.273	1	46	0.604
3.	Class 3	0.734	1	20	0.402
4.	Class 4	3.884	1	40	0.056

The values of p of all four classes are higher than 0.05, meaning the pretest and posttest for the learning outcome of the four classes have homogeneous data. After fulfilling the normality and homogeneity requirements, the learning outcome data were analyzed using the parametric statistic. The analysis aimed to identify the significance of the difference in students' learning outcomes before and after using basic pedagogy materials model learning application. Furthermore, independent t-tests were performed to measure the effectiveness of basic pedagogy materials and mobile learning applications in improving students' learning outcomes.

## Results

### *The Results of Media Development of Mobile Learning*

The development of the learning application was adjusted to the needs of the students and the lecturers to optimize the learning process. The product made is the application of mobile learning Basic Education Course. The materials in the application developed were based on the four subjects of educational major found on the mobile learning basic education course. They included Introduction to Education, Counselling Session, Educational Psychology, and School Management. The learning application comprised the opening, main part, and closing parts. The opening part consists of the title page and the 'login button to access the basic education course mobile learning course. There is a button that gives the alternative login through google, as shown in Figure 1. The main menu shows the units of the subjects in the learning application, as shown in Figure 2.



Figure 1. Login menu display in Mobile Learning Applications Containing Basic Pedagogy Materials as Complementary



Figure 2. Main menu of mobile learning Mobile Learning Applications Containing Basic Pedagogy Materials as Complementary

The main menu consists of the 'logout' button on the up-right corner and the 'search' button used to find and access the subjects. There is the 'Subjects' menu with the names of the subjects, such as Introduction to Education, Counselling Session, Educational Psychology, and School Management. The 'Popular Subject' menu shows the subjects frequently accessed with a high rating from the users.

The main part of the learning application course shows the menu of the subjects. The sub-menu contains the description of the subjects, the topic discussed, and the number of credits and participants following the lecture using the application. The bottom part shows the information on the Learning Accomplishment of the Subject. Besides. Also, the menu of 'Learning Topic' contains the learning materials according to the subjects accessed and presented through an explanation video. Figures 3 and 4 show one of the subject contents and the explanation video.



Figure 3. Content display in Applications Containing Basic Pedagogy Materials as Complementary



Figure 4. Display of the explanation video on Applications Containing Basic Pedagogy Materials as Complementary

The closing part contains the confirmation dialogue for the media used to close the application.

**Results of the Validity of Mobile Learning Applications for Basic Pedagogical Materials** The validity test of the mobile learning basic education course was performed before the product was tested in the learning. The learning application was scored and validated by the media and material experts. The scoring consisted of (a) the display, layout design, typography, image, animation, audio, video and general display; and (b) the programming, usage, navigation, and interactive link. Table 5 presents the expert scoring results.

Table 5. The results of the media expert's assessment on Applications Containing Basic Pedagogy Materials as Complementary

Aspect	Component	Score	Category
Display	Layout design	9	Very Valid
	Typography	13	Very Valid
	Image	13	Very Valid
	Animation	7	Valid
	Audio	7	Valid
	Video	9	Very Valid
	Packaging	13	Very Valid
Programming	Usage	14	Very Valid
	Navigation	10	Very Valid
	Interactive Link	9	Very Valid
Total Score		104	Very Valid

Table 5 shows that the scoring scored 104 in the “very valid” category. The minimum score for the learning application to be valid should exceed 76. Figure 5 compares results on the minimum criteria of validity of the application.

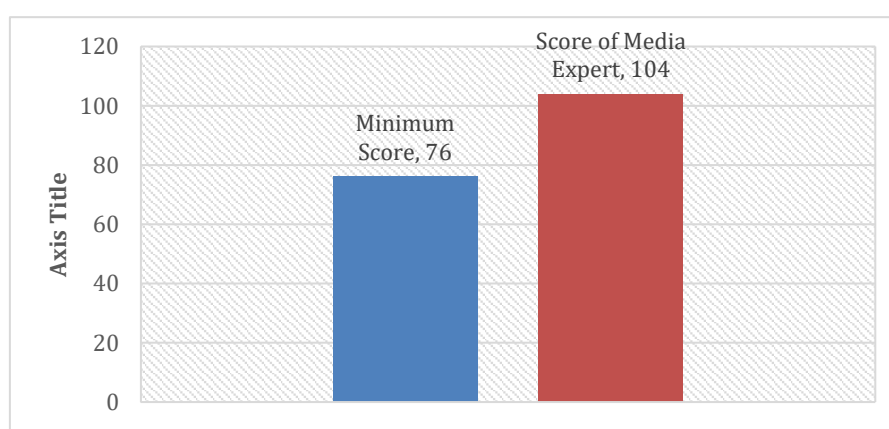


Figure 5. The comparison of the minimum score and the score from the expert media assessment on Applications Containing Basic Pedagogy Materials as Complementary

The scoring of the material expert also used the minimum criteria to be fulfilled by the media developed. The validity scoring by the material expert comprised (a) truthfulness, (b) degree of importance, (c) learnability, (d) attractiveness, and (e) media usefulness. Table 6 presents the scoring result.

Table 6. Scoring results from the material expert in the assessment on Applications Containing Basic Pedagogy Materials as Complementary

Aspect	Score	Category
Trueness of media	21	Very Valid
Degree of importance	18	Very Valid
Learnability	26	Valid
Attractiveness	11	Valid
Usefulness	10	Very Valid
Total Score	86	Very Valid

The scoring result by the content expert upon the application of mobile learning of basic education courses is 86 in the “very good” category. The minimum limit for the media to be classified as good is at least 7. The results showed that the content of the learning application is classified as good. Table 6 compares the content expert score on the minimum criteria for the learning application.



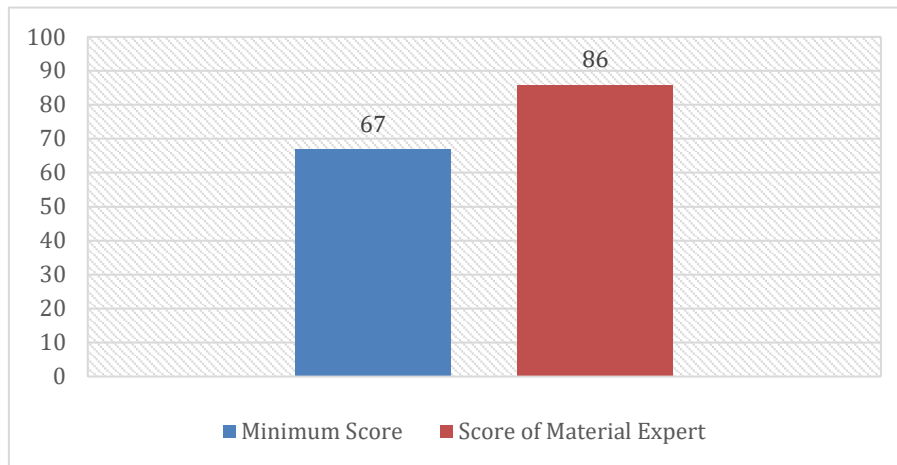


Figure 6. The Comparison of the Minimum score and the score from the content expert to assessment on Applications Containing Basic Pedagogy Materials as Complementary

The results showed that mobile learning application in basic education courses is classified as good for testing in the learning process. However, several suggestions could be given by the media and content experts to make the media developed more effective in the learning process.

#### *Effectiveness of the Learning Application of Mobile Learning Basic Education Course*

The effectiveness test involved the students and lecturers in the learning process. The learning application's effectiveness was measured from the average learning score of the students in four groups used as samples. The result before and after using the learning application was observed and compared. The average learning result was calculated using the dependent t-test with the data from the normality and homogeneity tests. Figure 7 shows the average score of the learning result of the students of Counseling Session 1 before and after using the learning application.

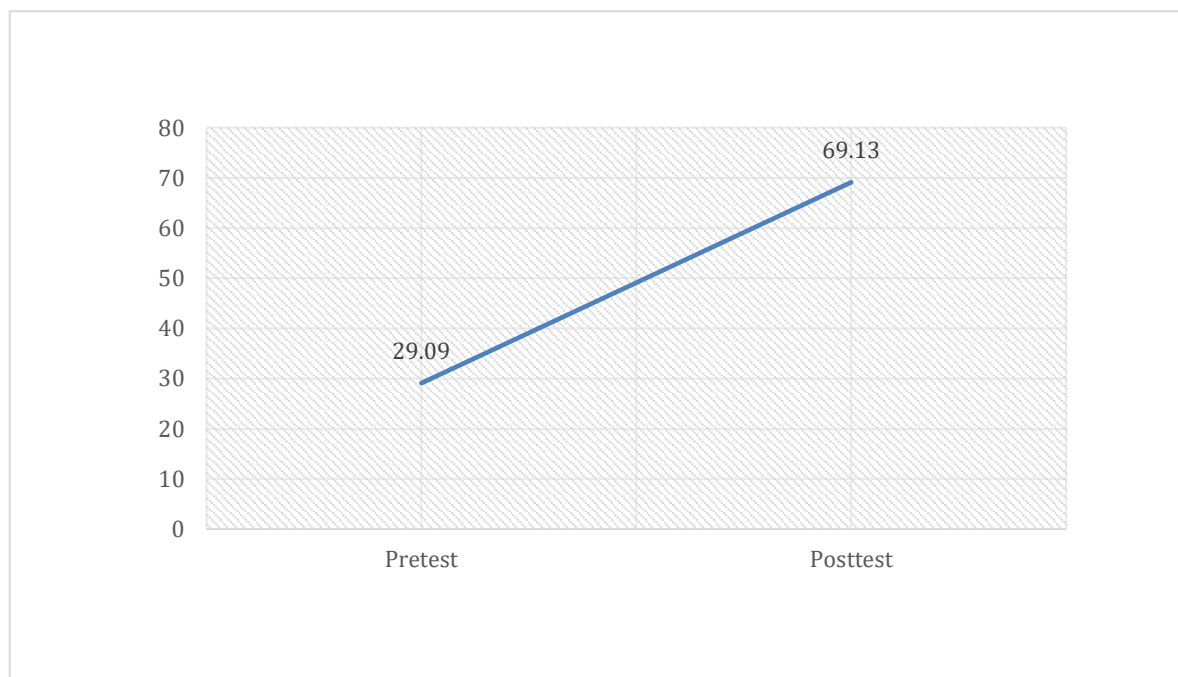


Figure 7. The Average Improvement of the Learning Results of Students Assessment on Applications Containing Basic Pedagogy Materials as Complementary

The findings show a 40.04 increase in student learning outcomes after using the mobile application. The n-gain value is 0.56, increasing in the "medium" category. Next, to see the statistical test results, there is a significant difference between learning outcomes before and before using learning applications in Table 7.

Table 7. The Result of the Dependent t-test

The Tested Data	Sig. (2-tailed)	Hypothesis	Note
Learning results of the students before and after using the learning application on the subject of Counselling Session-1	.000	( $p < 0.05$ )	There is a significant difference

The data in Table 7 show that the result of the dependent t-test is lower than 0.05 ( $p < 0.05$ ). This implies a significant difference in the students' learning results after using the mobile learning application. The figure presents the average data of the learning results in Counselling Session 2 before and after using the application.

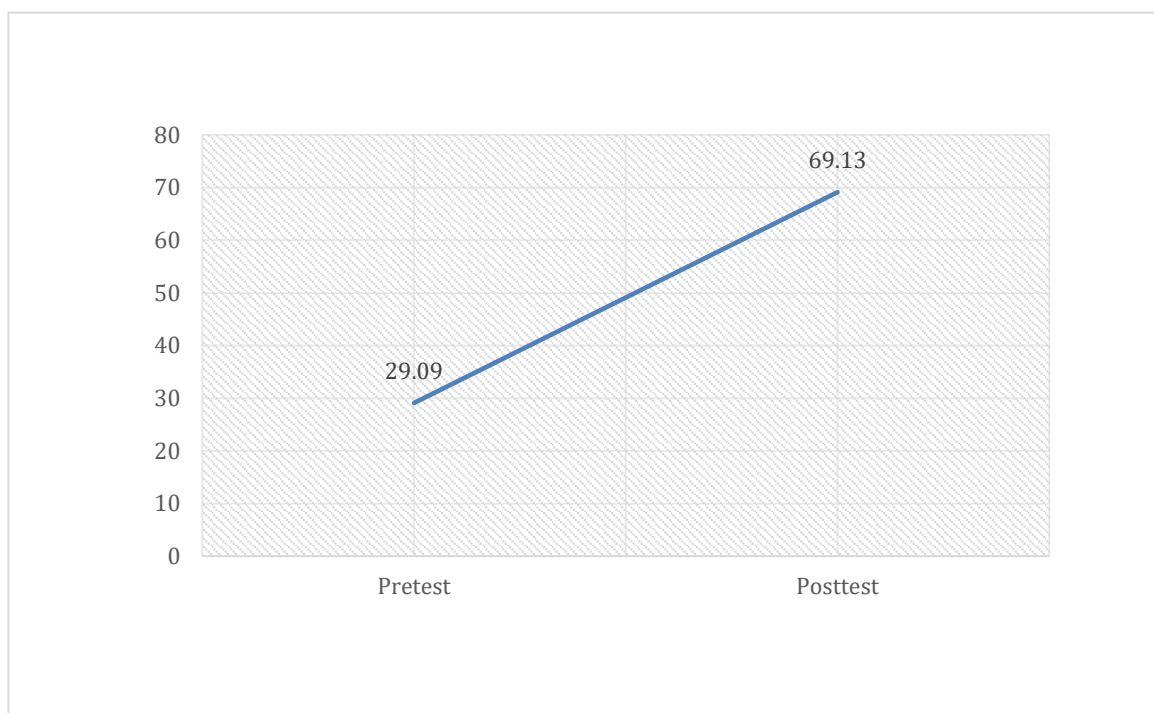


Figure 8. Improving Student Learning Outcomes in Counseling Guidance Subjects Using Applications Containing Basic Pedagogy Materials as Complementary

There is an improvement of 40.41 in the students' learning result in Counselling Session 2 after using the mobile learning basic education course. The n-gain is 0.58 in the "medium" improvement category. Table 8 shows the dependent t-test results.

Table 8. the result of the dependent t-test on the learning result of the students on the subject of Counseling guidance using Applications Containing Basic Pedagogy Materials as Complementary

The Data Tested	Sig. (2-tailed)	Hypothesis	Note
The learning result of the students before and after using the application on the learning of Counselling Session 2 subject	.000	( $p < 0.05$ )	There is a significant difference

Table 8 shows that the dependent t-test obtained a significance score smaller than 0.05 ( $0.000 < 0.05$ ). It means there is a significant difference in the students' learning outcomes after using the mobile learning application in Counselling Session 2. Figure 9 presents the data of the average learning result in Educational Psychology 1 before and after using the mobile learning application.

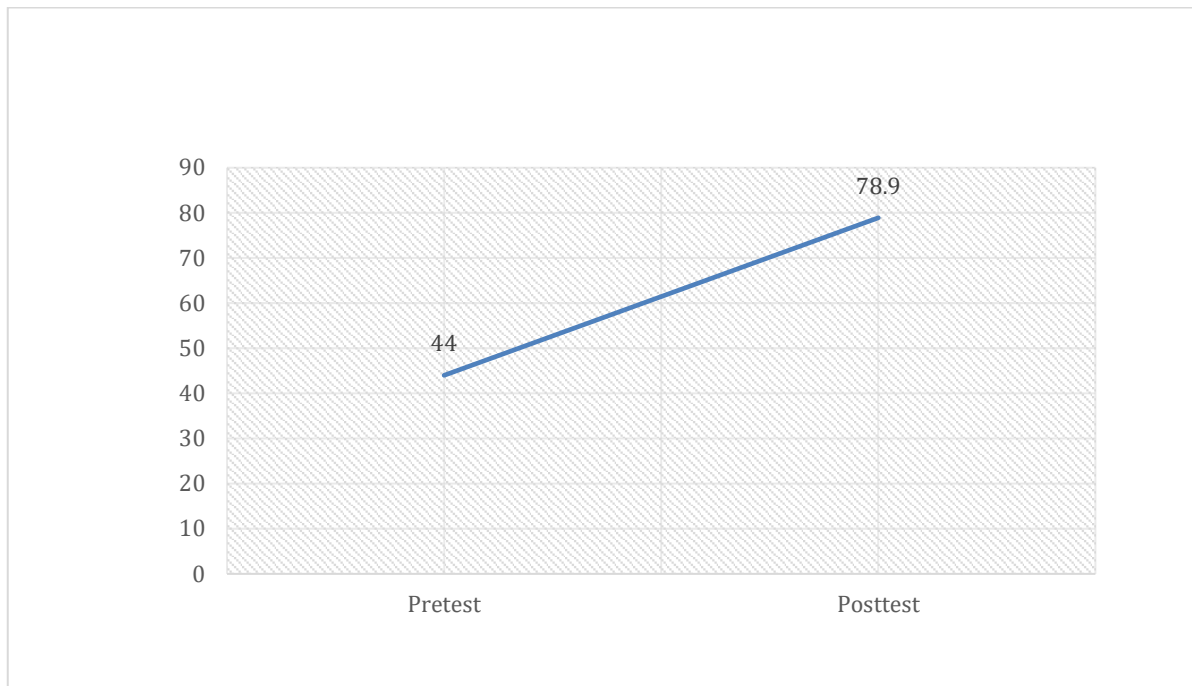


Figure 9. Average Learning Result of Educational Psychology-1

There is an improvement of 3.9 in the students' learning result on the subject of Educational Psychology 1 after using the mobile learning application. The n-gain score acquired is 0.62 in the "medium" category. Table 9 presents the dependent t-test results.

Table 9. Result of dependent t-test

The Data Tested	Sig. (2-tailed)	Hypothesis	Note
The learning result of the students before and after using the learning application on the subject of Educational Psychology -1	.003	( $p < 0.05$ )	There is a significant difference

The data in Table 9 show that the dependent t-test of the students' learning outcome in Educational Psychology 1 has a significance score lower than 0.05 ( $p < 0.05$ ). This implies there is a significant difference in the learning outcome after using the mobile learning application. Figure 10 shows the students' average learning outcome in Educational Psychology 2 before and after using the mobile learning application.

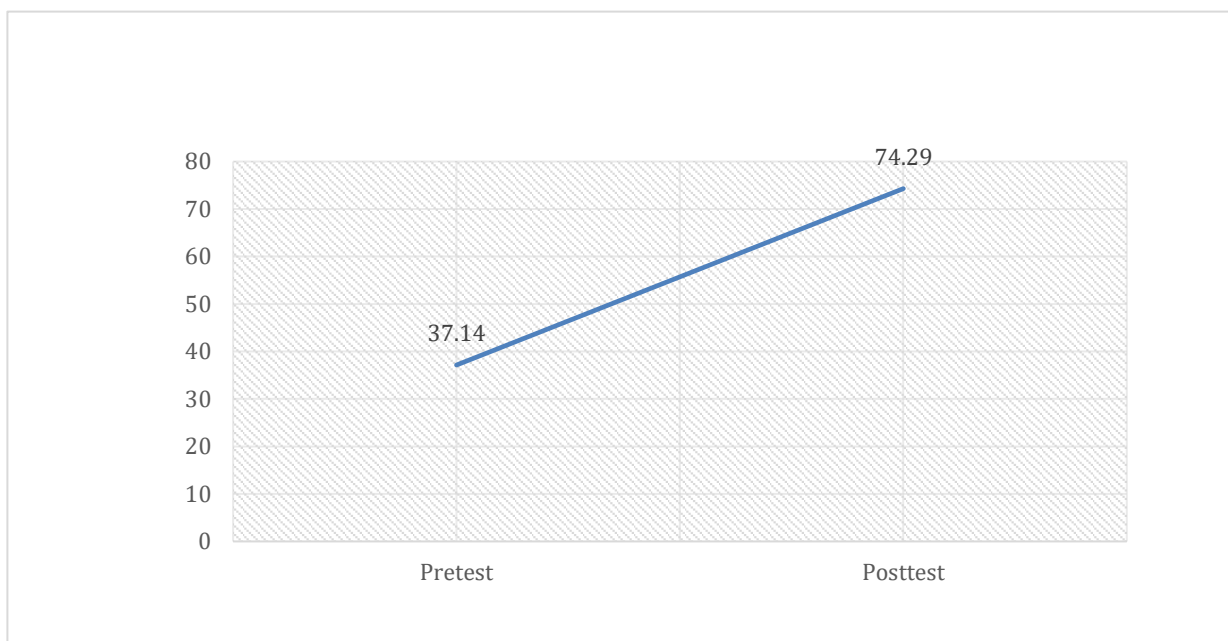


Figure 10. The Improvement of The Average Score on The Learning Result of The Students on Psychopen 2

Using Applications Containing Basic Pedagogy Materials as Complementary A significant improvement of 37.15 in the students' learning outcomes in Educational Psychology 2 is recorded after using the application. The n-gain score is 0.60 in the "medium" category. Table 10 presents the dependent t-test results.

*Table 10. The result of the dependent t-test on the learning result of the students on Psychopen 2 by using Applications Containing Basic Pedagogy Materials as Complementary*

<b>The Data Tested</b>	<b>Sig. (2-tailed)</b>	<b>Hypothesis</b>	<b>Note</b>
The learning result of the students before and after using the learning application on the subject of Educational Psychology -2	.003	( $p < 0.05$ )	There is a significant difference

The data in Table 10 indicates that the dependent t-test of the students' learning outcome in Educational Psychology 2 has a significance score lower than 0.05 ( $p < 0.05$ ). This signifies there is a significant difference in the learning outcome after using the mobile learning application. Therefore, the mobile learning application developed is valid and effective in improving student outcomes for college teachers and graduates.

### Discussion

This study examined the difference in the average score on the students' learning outcomes before and after using the mobile learning basic education course application. The results indicated that the android-based learning application effectively improved students' outcomes. This supports El-Sofany and El-Haggar (2020) that the students' outcomes improved when applying mobile learning. Students have a positive perception and better concentration, which help improve their skills in using technology in learning. According to Heflin et al. (2017), mobile technology positively influences students' critical thinking because it brings them closer to the tools used, and also improves learning outcomes (Miller & Cuevas, 2017). Therefore, technology supports the learning process in the current technological development era.

Learning effectiveness is generally influenced by learning media vital in storing information or teaching materials. Tafonao (2018) stated that learning media stimulates students' minds and makes learning more effective. Furthermore, Sainuddin and Taufiq (2016) stated that learning could be effective and efficient when accurate media are used to meet the needs of teachers and students. The usefulness of the media could be felt in the learning directly. Marpanaji et al. (2018) also stated that the development of the learning media must accommodate the needs of the students, including the learning objectives, characteristics, and materials.

Mobile learning basic education course is a development of the android-based learning application that contains education subjects. These subjects include Counselling Sessions, Introduction to Education, Educational Psychology and School Management. Several reasons make the Mobile learning basic education course effective in improving student outcomes. The application developed has elements such as texts, pictures, audio, and videos, each with roles in the learning process. Using the visual elements in the learning media could attract the students' attention, making them more enthusiastic about following the lesson (Verhallen & Bus, 2011; Yang et al., 2016). According to Amit et al. (2019), the visual elements could help the students remember the learned materials. They could also help the students understand the teaching materials (Dallacqua & Peralta, 2019). Similarly, the audio elements could positively influence the learning process. The learning media that contains an audio element improve the students' learning process (Curran & Seo, 2018; Taylor & Clark, 2010). Namaziandost et al. (2019) stated that audio elements help improve the students' listening skills and concentration, improving their understanding (Widyaningrum, 2015). According to Hughes et al. (2019), combining the video and audio elements could be a stimulus that accommodates the students in processing the information. The stimulus helps the students understand the learning material. This is in line with Chieke et al. (2017) that the visual and auditory elements influence the acceptance process.

The effectiveness of the learning application is also supported by the potential of mobile-based media. They should be flexible in terms of time and space, support the learning process that focuses on the students, and improve the collaboration and interaction between the students and teachers (Carlson & Schrader, 2012; YawAsabere, 2013). Grinols and Rajesh (2014) stated that mobile learning-based media are close and contextual to the students' recent life. They could deepen the learning experience through various sources (Achterkamp et al., 2016). According to Anshari et al. (2017), mobile learning-based media have many sources that could be used as wider and faster references to make learning more effective.

### Conclusion

This study aimed to develop and test the effectiveness of mobile learning basic education course's learning application in improving students' outcomes in the Teacher Training Institutes. The results showed that the android-based learning media effectively improves students' outcomes. The learning application developed has features according to the needs of the students. It motivates students, contributing to improving their outcomes. Moreover, the audio-visual elements in the mobile learning basic education course also help students understand the interactive teaching materials.

### Recommendation

Lecturers should use the learning media according to the characteristics and needs of the students. They could use the mobile learning basic education course media in teaching the affective and psychomotor aspects. These results are expected to improve innovation in learning media in universities. However, future studies should be conducted over a longer period and use more samples to gain more comprehensive data.

### Limitation

The mobile learning basic education course developed was not applied to all subjects learned in the Teacher Training Institutes. Therefore, it requires further development to complete the other subjects. The number of samples was also limited and should be increased in the future to determine the learning application's effectiveness more comprehensively. Furthermore, the study took a short duration and could not gain more in-depth data. It only focused on the cognitive aspect, necessitating future studies to develop the media for affective and psychomotor aspects.

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### Authorship Contribution Statement:

Ahmadi: Conceptualization, final approval. Hardyanto: Drafting manuscript. Pramono: Data analysis. Sugiarta: Writing, editing. Syahputra: Editing/reviewing. Kristanto: Admin. Parinsi: Editing. Sugihartono: Designing.

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