Journal of Education Technology
Volume 7, Number 4, 2023, pp. 752-762
P-ISSN: 2549-4856 E-ISSN: 2549-8290
Open Access: https://ejournal.undiksha.ac.id/index.php/JET

Implementation of Mobile Learning Design in the Flipped Direct Instruction Model to Increase Student Competency Using a Constructivist Approach

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ARTICLE INFO

Article history:
Received July 10, 2023
Revised July 11, 2023
Accepted November 12, 2023
Available online November 25, 2023

Kata Kunci:
Konstruktivisme, Flipped Direct Instruction, Instalasi Jaringan Komputer

Keywords:
Constructivism, Flipped Direct Instruction, Computer Network Installation

DOI:
https://doi.org/10.23887/jet.v7i4.69768

ABSTRAK

Pembelajaran mobile dengan pemanfaatan teknologi menjadi tantangan utama peserta didik generasi Z saat ini. Tantangan ini akan mempengaruhi kemandirian dan kemampuan peserta didik dalam belajar. Untuk itu tujuan penelitian ini yaitu menguji implementasi pembelajaran mobile menggunakan model Flipped Direct Instruction (FDI) dan mengembangkan media pembelajaran JarkomFDI dengan pendekatan konstruktivisme. Jenis penelitian ini yaitu Penelitian Quasi-Eksperimen. Kelas kontrol dan kelas eksperimen digunakan dalam penelitian ini. Model Direct Instruction (DI) diterapkan di kelas kontrol dan model FDI digunakan untuk kelas eksperimen. Penelitian ini menggunakan jenis data kuantitatif dan primer. Metode yang digunakan untuk mengumpulkan data yaitu angket dan tes. Instrument yang digunakan dalam mengumpulkan data yaitu kuesioner dan lembar soal. Teknik yang digunakan untuk menganalisis data yaitu analisis statistic kualitatif dan kuantitatif. Data diperoleh dengan menggunakan instrumen tes dan dikalkulasi menggunakan metode Gain Score. Hasil penelitian berupa media pembelajaran JarkomFDI berserta data pelaksanaan pembelajaran mobile. Data tersebut memperoleh persentase dari Gain Score yaitu 75,04% dengan persentase minimum 61,7% dan persentase maksimum 100,0%. Persentase 75,04% menjawab hipotesis penelitian ini bahwa terdapat terdapat pengaruh yang signifikan dari implementasi desain pembelajaran mobile pada model pembelajaran FDI dengan pendekatan konstuktivisme terhadap hasil pembelajaran praktikum Instalasi Jaringan Komputer. Disimpulkan bahwa model pembelajaran yang menggunakan mobile dengan pendekatan konstruktivisme, efektif dalam meningkatkan kemampuan kognitif dan psikomotor peserta didik. Hasil penelitian ini diharapkan dapat menjadi salah opsi yang mempuni untuk peningkatan efektifitas pelaksanaan pembelajaran Instalasi Jaringan Komputer.

ABSTRACT

Mobile learning using technology is the main challenge for Generation Z students today. This challenge will affect students' independence and ability to learn. For this reason, this research aims to test the implementation of mobile learning using the Flipped Direct Instruction (FDI) model and develop Jarkom FDI learning media using a constructivist approach. This type of research is Quasi-Experimental Research. The control class and experimental class were used in this research. The Direct Instruction (DI) model is applied in the control class, and the FDI model is used for the experimental class. This research uses quantitative and primary data types. The methods used to collect data are questionnaires and tests. The instruments used to collect data were questionnaires and question sheets. The techniques used to analyze data are qualitative and quantitative statistical analysis. Data was obtained using test instruments and calculated using the Gain Score method. The results of the research are Jarkom FDI learning media along with mobile learning implementation data. This data obtains a percentage of the Gain Score, namely 75.04%, with a minimum percentage of 61.7% and a maximum percentage of 100.0%. 75.04% answered the research hypothesis that there is a significant influence of implementing mobile learning design in the FDI learning model with a constructivist approach on the results of computer network installation practicum learning. It was concluded that the learning model that uses mobile with a constructivist approach effectively improves students' cognitive and psychomotor abilities. The results of this study are expected to be one of the qualified options for increasing the effectiveness of the implementation of Computer Network Installation learning.

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1. INTRODUCTION

Quality education is one of the efforts that can be made to change a person's potential to be better and more beneficial to the surrounding environment. Therefore, the government is trying various ways to improve the quality of education in Indonesia (Bakar et al., 2019; Daniati, 2022; Sukendro et al., 2020; Zurqoni et al., 2018). One level of education that prepares students to have skills in the world of work is vocational education (Soputan, 2017; Syauqi et al., 2020; Tentama et al., 2019; Zurqoni et al., 2018). Vocational education is a level of education that focuses on creating graduates who have skills so they are ready to work in industry (Antonietti et al., 2022;

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Fahmi et al., 2021; Hamburg, 2021; Tentama & Paputungan, 2019). In preparing quality graduates, various competencies are needed that are adapted to the demands of the 21st century. In the 21st century, students need complex skills such as critical thinking skills, creativity skills, communication skills, and collaboration skills (Jannah et al., 2021; Jufriadi et al., 2022; Peters-burton & Stehle, 2019; Salmia & Yusri, 2021).

The implementation of learning needs to be adjusted to the characteristics of current students. Current students are dominated by Generation Z students (Rastati, 2018; Reza et al., 2022). Generation Z students are synonymous with the ability to master technology (Firamadhina & Krisnani, 2020; Hasan Lubis & Darwis Dasopang, 2020; Lubis & Dasopang, 2020; Wijoyo et al., 2020). However, in learning, generation Z students are faced with several challenges. These challenges often become problems when they cannot be answered well. Such as the challenge of being able to utilize technological developments to learn independently. Previous research findings also show that Generation Z students prioritize using technology for entertainment rather than learning (Junjunan, 2019; Reza et al., 2022). Previous research findings also state that there are still many teachers who are unable to utilize technology to support learning activities (Fahmi et al., 2021; Kusumaningtyas et al., 2020; Wisada et al., 2019). The use of technology in learning can actually increase students' enthusiasm for learning significantly (Ida & Maksum, 2021; Sahudra et al., 2021; Suryawan et al., 2021).

Matter the can also be seen in observations carried out during the learning process for the Computer Network Installation Practicum at Department of Electronics Engineering, Faculty of Engineering, Padang State University, Indonesia. Observation results showed that students generally only rely on learning in the laboratory. Few students study the learning material before carrying out practical work in the laboratory. Even though learning time in the laboratory is very limited and the practical material is very complex. This is also reinforced by the results of students' initial knowledge tests. This test is carried out before learning begins. The test was carried out in 4 meetings. The results of data analysis showed that students' initial knowledge data was still in the low category. Initial knowledge abilities greatly influence students' capabilities in thinking critically, creatively and innovatively. Initial knowledge skills can also minimize the potential for practical accidents.

Based on these problems, in order to improve initial knowledge abilities, it is necessary to strengthen students' independent learning before learning in the laboratory. Various studies have proposed several alternatives to this problem Warju et al(2020) using Real Condition Video media in implementing the DI model for Basic Automotive Engineering subjects Rueden(2023) using learning machines to integrate prior knowledge into learning Hamidah et al(2018)using the inquiry learning model to strengthen students' initial knowledge to be able to learn independently. Previous findings stated that in order to build students' initial knowledge well, it is necessary to give prizes (Huang & Hew, 2018; Urh et al., 2015). Based on several solutions that have been described, we propose strengthening students' initial knowledge through mobile learning. Where this learning uses new learning models and media to realize mobile learning. The learning models are the Flipped Direct Instruction (FDI) learning model and the Jarkom FDI learning media in mobile learning.

Mobile learning is a learning model that involves mobile devices which facilitates students being able to access learning materials, learning instructions, and learning applications without being limited by space and time, wherever and whenever they are (Al-Adwan et al., 2018; Chen & Tsai, 2021; Lai & Hwang, 2014; Sepyanda et al., 2023; Soleimani et al., 2014). In implementing mobile learning, an effective learning model is needed as a guide for educators in implementing learning (Faridah & Santi, 2021; Joyce & Weil, 2003; Wangid et al., 2020). Use this guide so that learning objectives are achieved in accordance with the targets that have been set (Gurses et al., 2015; Joyce & Weil, 2003). The Flipped Direct Instruction (FDI) learning model is a learning model that has recently been developed. The FDI learning model was developed by (Mubai et al., 2023). The FDI model was designed and developed specifically for practical learning (Mubai et al., 2023). The FDI model was formed by combining the Direct Instruction model with the Flipped Classroom model. The FDI learning model consists of orientation stages, procedure-based simulation, case-based simulation, structured practice, guided practice, and independent practice. Each phase has different goals, methods, and times (Mubai et al., 2023). The orientation phase aims to build students' initial perceptions which is carried out indirectly and mobilely. The process-based simulation phase is carried out indirectly and mobile to form students' initial knowledge (Mubai et al., 2023).

In the case-based simulation phase, students are expected to be able to trigger their own critical thinking abilities. The structured practice phase is intended to directly prove what has been carried out on a direct procedure-based simulation. Likewise, the guided practice phase is aimed at directly proving what has been implemented in direct case-based simulations. The final phase is the independent practice phase, aimed at strengthening the understanding, memory and skills of students who have just acquired new knowledge (Mubai et al., 2023).The choice of the FDI model was because the FDI model was developed on the basis of constructivist learning theory. The use of constructivist learning theory is aimed at encouraging students to be able to build their own capabilities (Kristanto, 2021; Mulyati, 2016; Nurhidayati, 2017; Nurlina et al., 2021; Supardi et al., 2019; Suparlan, 2019). This capability will trigger the growth of students' abilities, especially in the cognitive aspect (Kamath & Kumar, 2023; Minarni & Napitupulu, 2020; Suwannaphisit et al., 2021; Zhou et al., 2020). This constructivist learning theory is so important in the learning process (Cai et al., 2021; Hasnah et al., 2019; Yustina & Kapsin, 2017).

The results of previous research found that students who were directed to learn using constructivism had critical thinking, goal orientations, and cognitive strategies (Kwan & Wong, 2015). Other research also confirms that students who are taught on a constructivist basis are more active in learning by asking questions and arguing (Minarni & Napitupulu, 2020; Sasson et al., 2018). Other research finds that student learning outcomes improve with learning based on constructivism theory (Imamah, 2012; Minarni & Napitupulu, 2020; Ugwuozor, 2020). The results of this research show that students who are able to build their own capabilities will have much better abilities so that learning outcomes increase (Minarni & Napitupulu, 2020; Sasson et al., 2018; Ugwuozor, 2020). This ability is mainly in the cognitive aspect of students (Kwan & Wong, 2015). In supporting the implementation of the FDI learning model, it is necessary to use appropriate learning media. The learning media needs to use learning media that has low abstraction, high independence, and good mobility. Therefore, this research aims to analyze the implementation of mobile learning design in the flipped direct instruction learning model using a constructivist approach.

2. METHOD

This Quasi-Experimental design research was carried out in the Computer Network Installation Practicum course in the Informatics Engineering Education (PTI) study program, Padang State University, Indonesia. Computer Network Installation Science has competency skills in the form of installing network transmission media, IP Address, Subnetting, Supernetting, VLSM, NAT, DNS, DHCP, Wireless, Hotspot, and Proxy (Arpan et al., 2018; Mubai et al., 2020). All of these competencies are currently needed in the industry (Agustini et al., 2018; Tasrif et al., 2020). In carrying out research implementation, the intact-group comparison method was used. The intact-group comparison method uses experimental and control groups as research samples. Research subjects are determined based on the number of classes available. Each class is given the symbol C and is followed by a sequence of class numbers. Groups that have been given a number are then given a class selection test (Ec/e) to choose class control (Cc) and class experiment (Ke) which is the subject of this research. Second election class this is based on the average member score class which has the smallest difference. This is the basis for stating that class the one chosen is class who have relatively equal or balanced abilities. The control and experimental classes that have been selected are then given treatment. Treatment for the control class (Cc) is use DI and AT learning models experimental class (Pe) model use learning FDI based on constructivism theory. After the treatment is given, a Pre-Test (Epre) is then given before learning begins for the experimental and control classes. The Post-Test (Epost) is carried out at the end of learning for each learning material.

The methods used to collect data are questionnaires and tests. The questionnaire method is used to analyze problems that occur in learning activities and assess student performance in discussions. The test method is used to test effectiveness Mobile Learning Design in the Flipped Direct Instruction Learning Model Using a Constructivist Approach. The instruments used to collect data were questionnaires and question sheets. The students Initial Knowledge test instrument grid is presented in Table 1.

Table 1. Prior Knowledge Test Instrument Grid

No	Learning Outcomes	Amount
1	Able to explain, calculate and interact with the concept of addressing (IP Address) on computer networks	15
2	Able to explain, calculate and interact with Subnetting concepts	15
3	Able to explain, calculate and interact with the Supernetting concept	15
4	Able to explain, calculate and interact with VLSM concepts	15
5	Able to explain, calculate and deconstruct the concept of routing a packet on a computer network	15
6	Able to explain, calculate and deconstruct the concept of computer networks connected to the internet network	15
7	Able to explain, calculate, and deconstruct the concept of wireless technology	15
8	Able to explain, calculate, and deconstruct the Proxy concept	15

The techniques used to analyze data are qualitative and quantitative statistical analysis. This research was carried out until the middle of the semester, to be precise until the VLSM material. The results of the test are calculated by testing N-Gain. Testing N-Gain was used to assess how big the impact of the treatment given to the experimental class was. The magnitude of the impact will be a benchmark in answering the hypothesis of this research. In using the method N-Gain some analysis requirements are required. Each requirement must be implemented before using the test N-Gain. After each requirement is met, you can use the method N-Gain. In determining or knowing the level of effectiveness of the N-Gain calculation, Hake's N-Gain category guidelines are used (Hake, 1999).

3. RESULT AND DISCUSSION

Result

The main problem in this research is the ability of students to build their own knowledge by utilizing technology. For this reason, to encourage students to be able to build their own knowledge, mobile learning is needed. In mobile learning, the FDI learning model is used as a learning model that uses indirect learning as a mobile learning model. To support this learning, the Jarkom FDI application is used. The Jarkom FDI application is designed using a mobile application base in the form of an .apk file. The Jarkom FDI application can be installed and used on smartphone devices with the Android system. Test results of class selection research instruments study, pre-test and post-test obtained a calculated r value that was greater than the table r value. This interprets that the instrument used is valid. The reliability test results for all instruments obtained very high reliability. Instruments that are valid and reliable are then used in the implementation selection of research classes, pre-test and post-test. The results of the validity and reliability of the instrument are presented in Table 2.

Table 2. Instrument Validity and Reliability Tests

Instrument	Validity			Reliability	
	R Count	R table	Status	Mark	Status
Class Selection Instrument	0.798	0.444	Valid	0.994	Very high
Pre-test Instrument	0.679	0.514	Valid	0.916	Very high
Post-test Instrument	0.759	0.632	Valid	0.903	Very high

Jarkom FDI application for Android smartphones. This application features learning content, exercises and challenge applications that can be used anywhere and anytime. Using the Jarkom FDI application requires an Internet connection, so the storage media used in the Jarkom FDI application is very small. The Jarkom FDI application is presented in Figure 1.

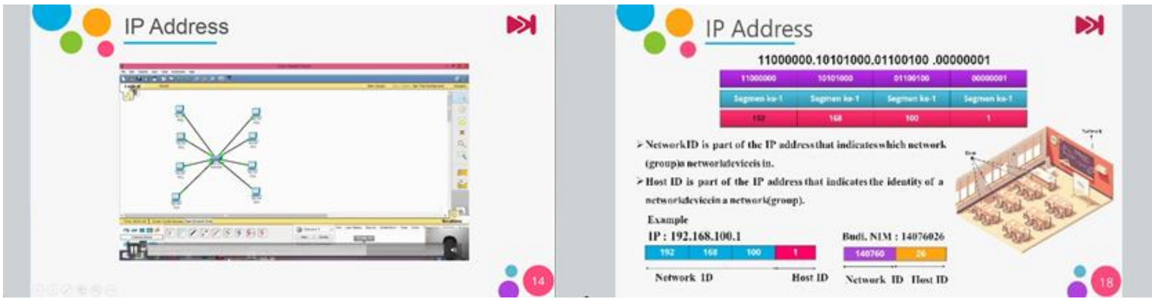

Figure 1. Jarkom FDI Application

The Jarkom FDI application that has been developed is implemented in conjunction with the FDI model for mobile learning. Starting with the testselection of research classes. Selection of research classes carried out in three classes of Informatics Engineering Education (PTI) class 3rd year (3F). The results of the pre-test are presented in Figure 2.

Figure 2. Research Class Selection Test

Results the implementation of research class selection was used as the basis for selecting control and experimental classes. For the select control classthat is 3F1 and experiment, namely 3F3. The selected control and experimental classes were given different treatments. Treatment for the control class uses the DI learning model and the experimental class uses the FDI learning model. The results of applying this treatment, further more tested on the pre-test and post-test.The results of the pre-test and post-test showed that the scores for the experimental class were 71.17 and 92.75, while the control class scored 45.61 and 72.08. Based on the comparison of these two values, the application of the FDI learning model is more effective to use. However, this does not answer the hypothesis in this research. In answering the hypothesis of this research,testing continued by using the N-Gain method which has several analysis requirements.Test normality in this research using the Shapiro Wilk method because the data obtained was less than 50 (Mishra et al., 2019). The data used are pre-test and post-test data in the control class and experimental class. The results of the calculations are presented in Table 3.

Table 3. Normality Test Results Data

Class		Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistics	df	Sig.	Statistics	df	Sig.
Data	Pre-Test Experiment	0.137	10	0.200	0.947	10	0.630
	Post-Test Experiment	0.204	10	0.200	0.869	10	0.097
	Control Pre-Test	0.123	12	0.200	0.956	12	0.723
	Control Post-Test	0.269	12	0.016	0.890	12	0.117

Based on Table 3 the significance values obtained sequentially were 0.630, 0.097, 0.723, and 0.117. The value of the four data is > 0.05, which means all data is normally distributed and can be processed with parametric statistics. The homogeneity test uses post-test data from the experimental class and control class for test variants of the two data. Variant testing is carried out to ensure that the data obtained is of the same type, produced by the same process and the same instrument. The results of the homogeneity test are presented in Table 4.

Table 4. Homogeneity Test Results Data

		Levene Statistics	df1	df2	Sig.
Data	Based on Mean	0.381	1	20	0.544
	Based on Median	0.233	1	20	0.635
	Based on Median and with adjusted df	0.233	1	15,611	0.636
	Based on trimmed mean	0.264	1	20	0.613

Based on Table 4 obtains a significant value (.Sig) of 0.544. A value of 0.544 > 0.05 interprets that the variance of the post-test data for the experimental class and control class is homogeneous. Independent t-test test in this study uses data *post-test* control and experimental classes. The results of the Independent T-Test are presented in Table 5.

Table 5. Independent T-Test Results Data

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Data	Equal variances assumed	0.381	0.544	6.390	20	0.000	20.66667	3.23412	13.92041	27.41293
	Equal variances not assumed			6.612	19.391	0.000	20.66667	3.12553	14.13377	27.19956

Based on Table 5 shows that the post-test data for the control class and experimental class has a sig (2-tailed) value of 0.002. Sig value. (2-tailed) 0.002 < 0.05, which means there is a significant difference in the average learning outcomes scores in the post-test data for the control class and the experimental class. This interprets that the learning model has an influence on learning outcomes. The significant t-test value allows the N-Gain test results to be used to answer the research hypothesis. Normalized gain (N-Gain) Score aims to determine the effectiveness of use something method or model in research. The N-Gain test was carried out in the experimental class using pre-test and post-test data.

Based on the results of the N-gain test calculation, the experimental class using the FDI learning model based on constructivism theory was 75.04% with a minimum value of 61.7% and a maximum value of 100.0%. A value of 75.04% interprets that the N-Gain value is in the High or Effective category. The N-gain value is effective in answering the hypothesis in this research, where the Alternative Hypothesis (H_a) is accepted and the Null Hypothesis (H_0) hypothesis is rejected. The H_a hypothesis is that there is a significant influence of the use of the FDI learning model based on constructivism theory on the learning outcomes of the Computer Network Installation practicum.

Discussion

The results of data analysis show that there is a significant influence of the use of the FDI learning model based on constructivism theory on the learning outcomes of the Computer Network Installation practicum. This is caused by several factors. First, the use of the FDI learning model based on constructivism theory can make learning easier. A learning model based on constructivism theory can encourage students to build their knowledge (Darwin et al., 2020; Hasnah et al., 2019; Suparlan, 2019). This is also in line with research that finds that constructivism can increase students' understanding by improving learning outcomes (Mulyati, 2016; Neftyan et al., 2018). In the FDI model, the formation of students' initial knowledge is facilitated in the first and second phases. In the first phase, students are given activities to watch learning videos (Mubai et al., 2023). Students can watch these videos anywhere and anytime on the Jarkom FDI application. When watching learning videos, perceptions will be formed (Aryani & Ambara, 2021; Hartanto et al., 2022; Sukarini & Manuaba, 2021). This perception will be concretized in the second phase. In the second phase, students are given activities to carry out simulations using a virtual simulator (Mubai et al., 2023).

Second, the use of the FDI learning model based on constructivism theory can increase students' enthusiasm for learning. Mobile learning in the Flipped Direct Instruction learning model with a constructivist approach is a learning approach that integrates mobile learning activities so that it can increase enthusiasm for learning. This is also supported by previous findings which also state that mobile learning which is packaged attractively can significantly increase students' enthusiasm for learning (Abbas et al., 2021; Diacopoulos & Crompton, 2020; Hanifah et al., 2020; Sukmana & Suartama, 2019; Agusa Suprianto et al., 2019). Moreover, students are very accustomed to using mobile devices in their daily activities. Utilizing mobile technology will allow students to study comfortably so that they can increase their enthusiasm for learning (Andriah & Amir, 2021; Bidin & Ziden, 2013; Kim et al., 2012; Wangid et al., 2020). The Flipped Direct Instruction learning model changes the traditional learning activities of lecturers and students. Lecturers can provide teaching materials via video or online learning materials before class meetings. Class time can be used for discussion, application of concepts, and collaboration. This can create fun learning activities. Apart from that, learning also uses a constructivist approach which emphasizes students (Duane & Satre, 2014; Hasnah et al., 2019; Kamath & Kumar, 2023). In this case, students can build their knowledge through reflection, discussion, and problem-solving. The use of mobile technology provides flexibility for students to explore content in a way that suits their learning style (Hanifah et al., 2020; A. Suprianto et al., 2019).

Third, the use of an FDI learning model based on constructivism theory can create an active learning atmosphere. The use of simulation places students at the center of their own learning (Smaldino et al., 2014; Warwick et al., 2016). This provides space for students to prove their newly acquired perceptions and knowledge from phase one. Apart from that, the use of simulators allows students to carry out experiments (Smaldino et al., 2014). For that on model FDI before learning in class, students are directed to build their own knowledge (Mubai et al., 2023). Student Those who already have knowledge are then triggered and re-honed to be able to be more critical. This is one indicator that students who are able to build their knowledge will have good critical thinking skills (Courtney et al., 2015). For this reason, in the FDI model, student creativity is facilitated in the third phase, namely case-based simulation. Cases that have been resolved can be proven directly in the fourth and fifth phases. The fourth phase is a place to prove the procedure-based simulation and the fifth phase is a place to prove the case-based simulation. Direct practice will strengthen knowledge in students who have already acquired previous knowledge. This is what makes students' knowledge more concrete.

The implications of this research areThe implementation of a constructivism-based learning model has a good impact on student learning outcomes. Additionally, viamobile technology, students can access learning materials anytime and anywhere, making it easier for students to learn (Huda et al., 2021). Learning activities like this allow students to organize their own study time and adapt it to individual needs and preferences. In addition, the use of mobile technology makes it easier for lecturers to monitor individual student progress and provide feedback more effectively (Sembiring et al., 2023). On the other hand, the Jarkom FDI application as a learning medium for Computer Network Installation is only compatible with the Android operating system. In this case, we have prepared a solution on operating systems other than Android, to be able to access the Jarkom FDI application via a link https://bit.ly/JarkomFDIApp in the browser application. This can help students feel supported and motivate them to continue studying independently whenever and wherever.

4. CONCLUSION

Implementation of mobile learning design using the FDI learning model and Jarkom FDI media with a constructivist approach has an effective impact on improving students' cognitive abilities. It was concluded that the learning model with a constructivist approach was able to facilitate thisstudentto build their own knowledge to be more critical, creative and innovative. This good knowledge has an impact on better skills and attitudes. For this reason, in every learning process a facility is needed that allows students to freely build their own perceptions, knowledge and beliefs.

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