Development of android-based learning application in EFI materials for vocational schools

N A Handoyono[1] and Rabiman[1]

[1]Mechanical Engineering Education, Faculty of Teacher Training and Education, Universitas Sarjanawiyata Tamansiswa, UH III/1043 Batikan Street, Umbulharjo, Yogyakarta, Indonesia

E-mail: arifin@ustjogja.ac.id

Abstract. The development of industry era 4.0 demands that education for 21st-century skills is not enough, but must consider management of learning in social aspects and virtual learning. Smartphones can be used as mobile learning in learning to support the industry era 4.0. This study explains the design and analysis of the performance of android-based learning application on EFI service material. This type of research is Research and Development with a 4D model. The research subjects were class XI Automotive students at SMK Perindustrian Yogyakarta consisting of 30 students. The technique of collecting data uses observation and questionnaires. Data were analyzed descriptively qualitatively and quantitatively to determine the feasibility of an Android mobile application. Android-based learning application on EFI service material developed using Appinventor 2 which is accessed online via Url: http://ai2.appinventor.mit.edu. The development of an Android-based learning application on EFI material gets a very good category. Android-based learning application on EFI service material is effectively applied in learning.

1. Introduction

Education aims to develop human potential. Through human education get knowledge, skills, and attitudinal values, so that they have a mindset that is systematic, rational, and critical of the problems faced and able to compete in the current global era [1] [2]. Education can be implemented requiring a learning process that is carried out interactively, inspiring, fun, challenging, motivating students to actively participate, and providing sufficient space for initiatives, creativity, and independence following the talents, interests, and physical and psychological development of students.

Ideally in learning the teacher must be able to communicate clearly and attractively with students [3]. With the creation of a conducive learning climate, it is hoped that it can create an active, creative, effective, and meaningful atmosphere among students during the learning process. Learning media are the key role of success in learning communication [4]. This is reinforced by the results of the study that the presence of learning media can streamline the learning process [5].

The challenge of education in Indonesia now that needs to be developed is media-based learning [6]. The media in question is mobile learning by utilizing gadgets and internet networks as learning resources [7]. Internet network is a very important aspect in industry era 4.0 where online integration occurs to

increase productivity. The development of industry era 4.0 demands that education for 21st-century skills is not enough, but must consider management learning in social aspects and virtual learning [8].

Indonesia's population has not been separated from internet use. This is indicated by the survey results that as many as 143.26 million people or 54.66% of Indonesia's population use the internet in their daily lives [9]. The data also states that the devices used were 44.16% using smartphones/tablets, 4.49% using computers/laptops, and 39.28% using both devices (smartphones/tablets and computers/laptops).

The use of internet networks can also be found by students of SMK Perindustrian Yogyakarta. Most students use an Android-based smartphone to access the internet. The use of smartphones by students of SMK Perindustrian Yogyakarta is still not optimal because students use the smartphone only to be limited to entertainment, such as playing games and social media. Learning in SMK Perindustrian Yogyakarta still refers to conventional, which is limited to the source of printed teaching materials. Though this smartphone should be used alternative teaching materials in accordance with the development of science and technology. In accordance with the demands of the Industry 4.0 era, students should be able to use internet network connections to support learning.

To support industry era 4.0, smartphones can be used as mobile learning in learning [10]. The need for the use of smartphones as mobile learning, especially in EFI service subjects because so far the teaching materials made by teachers are still limited and only as teachers. The use of instructional media that is less interactive and sometimes makes students less understanding the reading of the picture as a whole. With the problems that have been raised, therefore smartphones will be more maximized in their use in learning as interactive multimedia teaching materials that can be accessed and owned by students. The advantages of interactive multimedia can be used by students to repeat material and independent learning [11]. Improvement of the learning process in EFI service subjects in the form of developing an Android-based learning application.

1.1. Android mobile learning

Mobile learning is part of electronic learning or better known as e-learning. Mobile learning as a combination of cloud computing and e-learning is a source that can be accessed anywhere, facilitating information search and interaction, so it supports effective learning without limitations of space and time [12]. Technically mobile learning is personal learning that connects students with the internet using gadgets [13]. The gadget in question is a PDA, cellular telephone, laptop, tablet PC, and so on. By utilizing cell phones, students will be easier and more flexible in accessing learning media without being limited by space and time.

Android is an operating system for Linux kernel-based cell phone devices that includes operating systems, middleware and applications. The Android operating system is very popular with the community because it is user-friendly and easy to use [14]. In Indonesia, android users accounted for 93.22%, the remaining 5.52% were IOS users and 0.12% were windows users [15]. Android is distributed with two types, namely, first, which has full support from Google or Google Mail Service (GMS) and the second is those that do not get support directly from Google or Open Handset Distribution (OHD) [16] [17]. Android has become the operating system for cellular phones or what is known as smartphones in the present and in the future [18].

2. Method

The type of research used is Research and Development (R & D) with a 4D model [19]. This development model consists of 4 stages, namely: (1) define; (2) design; (3) develop; and (4) disseminate.

The research subjects were class XI Automotive students at SMK Perindustrian Yogyakarta consisting of 30 students. The object of research is an android-based learning application on EFI material.

Data collection techniques are carried out by observation and questionnaire. Observation is used to determine the learning media needs developing in the form of android-based learning application on EFI material. The questionnaire contains an assessment of the feasibility of an Android-based learning

application by media experts, material experts, teaching teachers, and students as users. For small group trials using 10 students and large group trials using 30 students.

The process of collecting data uses research instruments consisting of observation sheets and questionnaires. The observation sheet is carried out by observing the students' grades and the learning process so that the results of the observations as a reference in making android-based learning application on EFI material. The questionnaire sheet is used to measure the feasibility of the Android mobile application.

Data were analyzed qualitatively and quantitatively. Qualitative data in the form of descriptive data obtained from the results of validation by experts, the results obtained are used as a reference for product revisions. Quantitative data is obtained from changing qualitative data using a Likert scale with a scale of 4 (very good), 3 (good), 2 (enough), and 1 (less). Next, calculate the feasibility percentage using the formula:

$$\% = \frac{\text{Observed score}}{\text{Expected score}} \text{ x } 100\%$$

After determining the percentage of eligibility, by referring to table 2 to determine the feasibility value of the product produced. The feasibility value for the product is set at a minimum "Good" criteria.

Table 1. Percentage Scale and Criteria

Percentage of Achievement	Criteria
81% - 100%	Very Good
61% - 80%	Good
41% - 60%	Enough
21 – 40%	Less
0 – 20%	Very Less

Android-based learning application developed is said to be effective in terms of student learning outcomes data which includes improving learning outcomes and completeness of learning outcomes. Improved learning outcomes using the gain test using the following formula [20]:

$$\text{N gain} = \frac{\text{Posttest score} - \text{Pretest score}}{\text{Ideal score} - \text{Pretest score}}$$

Based on the N-gain calculation obtained then the score categories in table 3 are used as follows:

Table 2. Distribution of Gain Scores

N-gain score	Category
$g > 0,7$	high
$0,3 \leq g \leq 0,7$	medium
$g < 0,3$	low

Criteria in improving learning outcomes are students with a minimum medium category. Android-based learning application is effectively used in learning if it meets the percentage of classical completeness reaching a minimum of 75%. The completeness criteria set are at least 75.

3. Result and discussion

3.1. Define stage

The defining stage is carried out as an initial stage in the android-based learning application on EFI material that passes several steps, namely initial analysis, student analysis, task analysis, concept analyst, and specification of learning objectives.

The final preliminary analysis step is used to find the root of the problems faced in EFI Service subjects. The preliminary analysis was carried out by observing and interviewing EFI Service subject teachers. In this analysis found problems during learning students tend to be passive in learning where the majority of teachers still use the method of lecture learning and demonstration. Teacher teaching materials are still limited and only as a teacher's handbook, so learning is only teacher-centered. The limitation of teaching materials is a consideration for developing a media that contains EFI material.

The next step is the analysis of students with the findings of knowledge about EFI by students is low because of the lack of learning resources available to students. On average, all students have an Android cell phone that should be used to find learning resources related to EFI material. But in reality, students only use limited text, telephone, social media, and play media. The impact of not maximizing Android mobile phones by students has an impact on the low value of EFI Service Engine subjects, which is only 60% of 30 students who achieve grades above completeness of learning outcomes, while the rest are still below the completeness of learning outcomes. With this result, it can be used as a consideration to use an Android mobile as a learning media by installing an Android-based learning application that contains EFI material. Android phones are chosen because on average each student has them, apart from that the use of an Android cell phone can make it easier for students to repeat the material because it is easy to carry everywhere and is not easily damaged because the media is used in the form of application.

The next step is the analysis of students with the findings of knowledge about EFI by students is low because of the lack of learning resources available to students. On average, all students have an Android cell phone that should be used to find learning resources related to EFI material. But in reality, students only use limited text, telephone, social media, and play media. The impact of the use of an Android cell phone that is not optimal by students has an impact on the low value of EFI Service subjects, which is only 60% of 30 students who reach the score above the completeness criteria, while the rest are still below it. With this result, it can be used as a consideration to use an Android mobile as a learning media by installing an Android-based learning application that contains EFI material. Android phones are chosen because on average each student has them, apart from that the use of an Android cell phone can make it easier for students to repeat the material because it is easy to carry everywhere and is not easily damaged because the media is used in the form of application.

The next step is analyzing the concepts carried out by looking at the syllabus and reference books for EFI Service Engine subjects. Based on these results, it can be seen that the EFI main material presented is (1) Definition of the EFI system, (2) EFI work system, (3) Types of injection systems, (4) Sensors, and (5) Actuators.

The final step of the define stage is the specification of the learning objectives. At this stage compile the framework of the program structure and design an android-based multimedia learning interface with EFI material. The results of the design framework in the form of program structure can be seen in Figure 1 below:

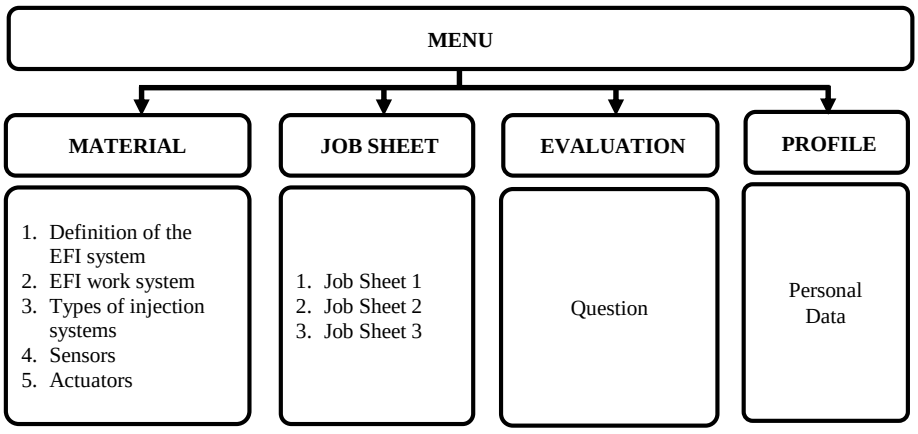


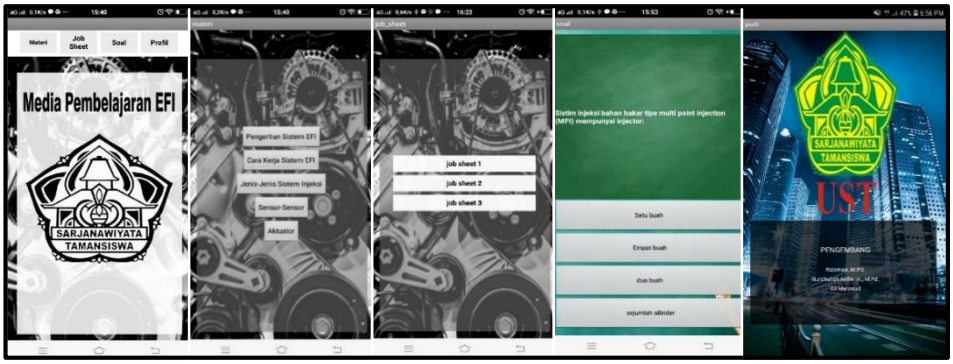
Figure 1. Program Structure Design Framework

3.2. Design stage

The design stage is carried out with several steps, namely the preparation of instruments, media selection, and format selection. Some of the steps taken aim to find out the types of learning materials and media that are suitable for development and obtain assessment and advice information from experts so that the media developed is in line with expectations.

The preparation of instruments in the form of questionnaires used for the feasibility test of experts includes material experts and media experts. Apart from experts, in the application development, there will also be a feasibility test of the android mobile application by teacher and students for the trial of small groups and large groups as input revisions. Aspects of due diligence for material experts and teacher include sub-topics of material with the syllabus, relevance of material, the content of the material, and benefits. Aspects of due diligence for media experts include appearance, content, language, operation, and purpose. Small or large group test aspects include the relevance of the material, the content of the material, ease of operation, navigation, and layout.

The selection of learning media formats to be developed is an android-based learning application. This is due to the consideration that almost all students have an Android cell phone and make it easier for students to repeat the material because it is easy to carry everywhere. The results of designing the initial android mobile application can be seen as follows:



(a) (b) (c) (d) (e)

Figure 2. Product Start Design: (a) Screen Title; (b) Screen Material; (c) Screen Job Sheet; (d) Screen Problem; and (e) Screen Profile

3.3. Develop stage

The develop phase is to revise the android-based learning application after getting input from material experts, media experts, and teacher. First, the advice of media experts is that the color is clarified so that it will make the display attractive. Second, advice from material experts, namely material in the form of a summary or more simplified. Third, the suggestion from the teacher is that questions are expected to emerge immediately by the scores obtained by students so that what is expected can be connected to students directly. Fourth, the suggestion from a small-group trial that is a foreign language is given a description of the Indonesian language version, so students can understand younger. Based on these suggestions, the application is then revised in terms of appearance by giving a more interesting coloring, the material is more summarized, questions in the application that are made immediately appear when the score is completed, and the provision of Indonesian terms in a foreign language.

Retrieval of feasibility test data was carried out with a questionnaire instrument. The feasibility test of an Android-based learning application is analyzed based on the results of the assessment by material experts, media experts, teacher teachers, and responses by students in small groups. The results of the feasibility of an Android-based learning application are considered feasible when in the minimal category "Good".

The results of the assessment of the feasibility of the android-based learning application by media experts on the display aspects were 87.5% including very good category, the content aspect of 81.2%

including very good category, the language aspect of 100% including very good category, operating aspects of 75% including good category, and the purpose aspect of 75% including good category. Overall, the five aspects get results of 83.74% including very good category.

The results of the assessment of the feasibility of the android-based learning application by material experts on aspects of material substance with syllabus were 100% including very good category, material relevance aspects of 85% including very good category, material content aspects of 87.5% including very good category, and the benefits aspect of 100% including very good category. Overall, the four aspects get results of 93.1% including very good category.

The results of the assessment of the feasibility test of android-based learning application by teacher on aspects of material substance with syllabus were 91.6% including very good category, material relevance aspects of 91.6% including very good category, material content aspects of 100% including very good category, and the benefit aspect of 87.5% including the very good category. Overall, the four aspects get results of 92.67% including very good category.

The results of the assessment of small group trials on the aspects of material relevance were 81% including the excellent category, the material content aspect of 80.6% including very good category, easy operating aspects of 80% including good category, navigation aspects of 83.5% including very good category, and the layout aspect of 83.75% including very good category. Overall the five aspects get results of 81.77% including very good category.

The summary of the results of the feasibility test of an Android-based learning application by material experts, media experts, teacher, and small group trials can be seen in Figure 3 below:

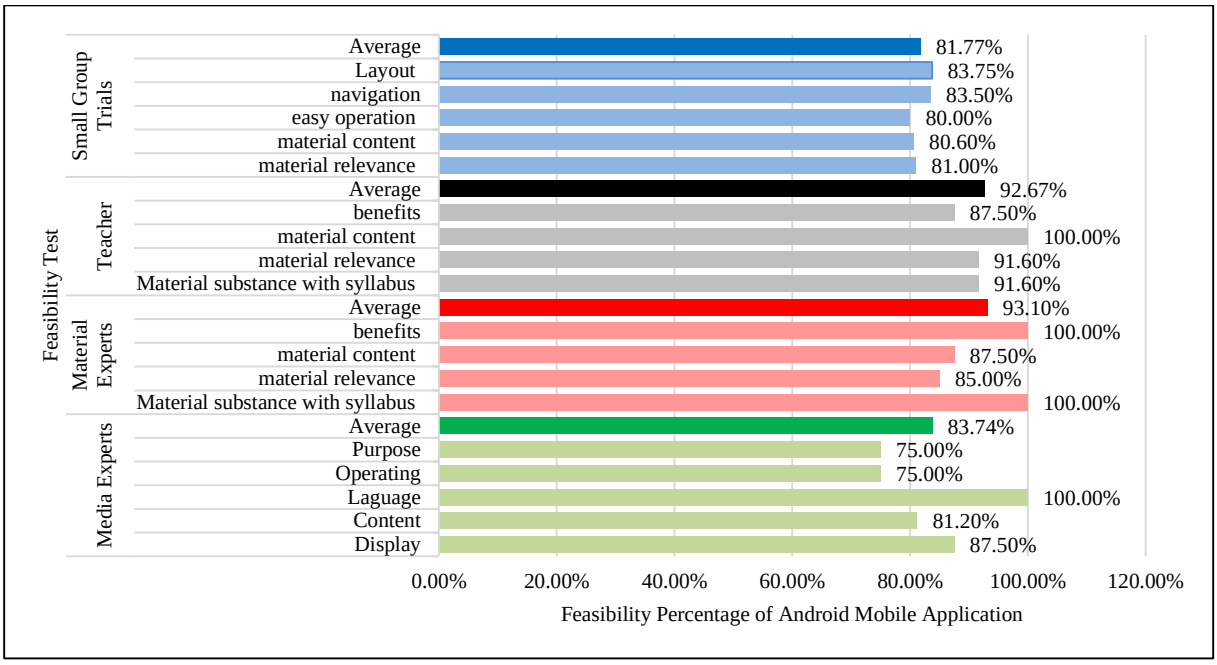


Figure 3. Feasibility test results of Android-based learning application by material experts, media experts, teacher, and small group trials

3.4. Disseminate stage

At the stage of deployment of android-based learning application ready to be distributed to students as a large group trial. Deployment is done by sharing the download link by Url: https://drive.google.com/open?id=1HSHQpbZuf-w-Pve8eTnAaXmeb8go7zc5 via WhatsApp. The results of the large group trial are as follows:

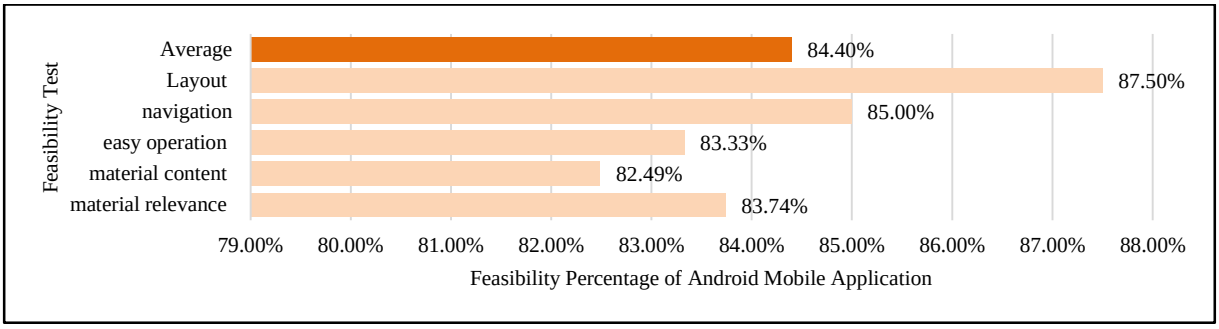


Figure 4. Feasibility test results of Android-based learning application by large group trials

In the large group trials, the results of the assessment on aspects of material relevance were 83.74% including the excellent category, the material content aspect was 82.49% including the excellent category, easy operating aspect of 83.33% including very good category, navigation aspects of 85% including very good category, and layout aspects of 87.5% including very good category. Overall, from the five aspects, the results of 84.4% including very good category.

Test the effectiveness of android-based learning applications using 2 types of data, namely the pretest and posttest scores. N-gain results obtained a value of 0.53 including the medium category, meaning that by using an android-based learning application can improve student learning outcomes. The number of students who meet the completeness criteria of learning outcomes at the pretest is 10%, while at the pretest is 100%, meaning that students experience an increase in learning outcomes by 90% and an android-based learning application effectively used as learning media on EFI material because it meets the percentage of classical completeness minimum of 75%.

With the Android-based learning application on EFI material, it allows students to get information and learning material effectively and efficiently that can be accessed anywhere and anytime. With mobile learning, students can take short quizzes and tests in their spare time, which further enriches the experience [21]. The results of the study also show that the use of android mobile learning can streamline learning, meaning the learning system that utilizes a smartphone can make learning more fun and interactive. Mobile learning is the first step in digital learning in the future, especially in uprooting the industry era 4.0. The Android mobile learning system can be used by educational institutions, such as instructors, teachers, and lecturers to provide study notes in digital format accompanied by an evaluation of learning.

4. Conclusion

Based on the discussion of the development of an Android-based learning application on EFI material, it can be concluded that the Android-based learning application on the EFI material developed using Appinventor 2 is accessed online. The feasibility test of an android-based learning application on EFI material by the experts gets results very feasible to use. This learning application is effectively applied in learning and makes it easier for students to get teaching material

5. References

[1] Republik Indonesia, "Undang-Undang Sistem Pendidikan Nasional No. 20 Tahun 2003," in *Sekretariat Negara*, 2003.
[2] I. W. Djatmiko, "A Study On the Empowering Teachers' Professional Development and Quality Assurance to Increase Teachers' Effectiveness in Vocational Secondary Schools," *J. Pendidik. Teknol. dan Kejuru.*, vol. 23, no. 2, pp. 144–151, 2017.
[3] J. H. Stronge, P. D. Tucker, and J. L. Hindman, *Handbook for qualities of effective teachers*. 2004.
[4] M. Chávez Arcega, "Instructional technology and media for learning," *Rev. Mex. Investig. Educ.*, 2010.
[5] N. A. Handoyono and S. Hadi, "Pengembangan Modul Pembuatan Bodi Kendaraan dari Fiberglass

Untuk Mendukung Perkuliahan Cat Dan Bodi Kendaraan," *Taman Vokasi*, vol. 6, no. 1, pp. 36–44, 2018.
[6] OECD and ADB, *Education in Indonesia: Rising to the Challenge*. 2015.
[7] G. Jinlong, T. Yawei, and S. Zhaolei, "Mobile learning research-based intelligent mobile phone and 3G networks," in *Proceedings of the 2012 2nd International Conference on Instrumentation and Measurement, Computer, Communication and Control, IMCCC 2012*, 2012.
[8] V. Puncreobutr, "Education 4.0: New Challenge of Learning," *Humanit. Socio-Economic Sci.*, vol. 2, no. 2, pp. 92–97, 2016.
[9] APJII, "Infografis Penetrasi & Perilaku Pengguna Internet Indonesia," *Asosiasi Penyelenggara Jasa Internet Indonesia*, 2017. [Online]. Available: https://apjii.or.id/content/read/39/342/Hasil-Survei-Penetrasi-dan-Perilaku-Pengguna-Internet-Indonesia-2017.
[10] K. Nachiketa, A. Rahatekar, A. Dhotre, and S. Saoji, "Developing an Android Based Learning Application For Mobile Devices," *Int. J. Adv. Comput. Sci. Cloud Comput.*, vol. 1, no. 1, pp. 36–38, 2013.
[11] Y. Munadi, *Media Pembelajaran Sebuah Pendekatan Baru*. Jakarta: Gaung Persada, 2008.
[12] C. Quinn, "mLearning. Mobile, Wireless, In-Your-Pocket Learning," *Line Zine*, 2000. [Online]. Available: https://www.linezine.com/2.1/features/cqmmwiyp.htm.
[13] M. Gharibpoor, S. Sargazi, and M. Aref, "Efficiency evaluation of e-learning compared to traditional education in human resource development (Case study: Small and medium enterprises in Shiraz)," in *2013 7th International Conference on e-Commerce in Developing Countries: With Focus on e-Security, ECDC 2013*, 2013, pp. 128–135.
[14] Prasad S, "A Study on: Attitude of Indian Customers towards Smartphones of Android and Windows Version," *J. Account. Mark.*, vol. 5, no. 2, p. 5: 167, 2016.
[15] Statcounter, "Mobile Operating System Market Share Indonesia," *Statcounter Globalstat*, 2019. [Online]. Available: http://gs.statcounter.com/os-market-share/mobile/indonesia.
[16] N. Safaat, *Android: Pemrograman Aplikasi Mobile Smartphone dan Tablet PC Berbasis Android (Edisi Revisi)*. Bandung: Informatika Bandung, 2012.
[17] K. Tam, A. Feizollah, N. B. Anuar, R. Salleh, and L. Cavallaro, "The Evolution of Android Malware and Android Analysis Techniques," *ACM Comput. Surv.*, vol. 49, no. 4, p. 76, 2017.
[18] K. W. T. G. T. Priyankara, D. C. Mahawaththa, D. P. Nawinna, J. M. A. Jayasundara, K. D. N. Tharuka, and S. K. Rajapaksha, "Android based e-Learning solution for early childhood education in Sri Lanka," in *Proceedings of the 8th International Conference on Computer Science and Education, ICCSE 2013*, 2013.
[19] S. A. O. Thiagarajan, *Instructional development for training teachers of exceptional children: A sourcebook*. 1974.
[20] R. R. Hake, "Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses," *Am. J. Phys.*, vol. 66, no. 1, pp. 64–74, 1998.
[21] H. F. Hanafi and K. Samsudin, "Mobile learning environment system (MLES): The case of Android-based learning application on undergraduates ' learning," *Int. J. Adv. Comput. Sci. Appl.*, vol. 3, no. 3, pp. 63–66, 2012.