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DOptik : Index Card Match Learning Application to Improve Students's Learning Outcomes in Light Diffraction (Feasibility Test)

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ABSTRACT

The success of a learning is influenced by several factors. Media and learning models are important factors in supporting learning success. This study aims to develop physics learning applications, especially in light diffraction materials that are suitable for use by high school students based on active learning type Index Card Match (ICM) to improve student learning outcomes especially in the post-covid-19 pandemic era. By using learning media in the form of applications and active learning models, learning can take place effectively and conductively so that student learning outcomes can increase. The method used is a 4D model, but only up to the development stage. The feasibility of this blueprint application was tested using a questionnaire that has 10 questions with 6 indicators and involves 24 students from several universities in Indonesia who are studying physics. The results of the questionnaire were analyzed using the interval success method and then categorized into 4 Assessment Scales. The results showed that the learning application developed is very feasible to use on all indicators that got 4.095 on average final score. This blueprint application can be developed into applications that are ready for use by students and applications that can be developed at the material and other levels. The results showed that the learning application developed is very feasible to use on all indicators that got 4.095 on average final score. This blueprint application can be developed into applications that are ready for use by students and applications that can be developed at the material and other levels. The results showed that the learning application developed is very feasible to use on all indicators that got 4.095 on average final score. This blueprint application can be developed into applications that are ready for use by students and applications that can be developed at the material and other levels.

Keywords :*Diffraction; Index Card Match; Outcomes.*

I. INTRODUCTION

Light diffraction is one of the materials of light wave physics which studies the phenomenon of bending of light due to an obstacle. Students experience difficulties with light waves because they do not understand physical phenomena and only focus on formulas [1]. The learning media used by the teacher is dominated using power point which is filled with material and lacks animation and simulation so that students still experience difficulties [2]. The development of learning media especially on light diffraction material is very much needed in this globalization era as it is today because the use of learning media such as printed books is less relevant [3]. In addition, currently Indonesia is entering the post-covid-19 pandemic era, where learning is held both offline and online according to the covid-19 situation. A flexible and portable learning medium is needed so that it can be used both for offline and online learning. Learning media in the form of mobile applications makes it easy to take anywhere [4]. One of the most widely used mobile operating systems lately is android. Thus, the android application can be an alternative learning media in the post-covid-19 pandemic era.

Learning media in the form of applications android is a medium for conveying learning material that is

operated via a smartphone. Criteria that must be found in using android applications as learning media, namely the developed android application must have easy navigation, contain cognition, fulfill learning needs, and be able to integrate aspects of objectives, materials, and learning methods [5]. Therefore, the development of learning media in the form of android applications must be in accordance with the basic competencies of learning, support lesson content, have easy navigation, and technical quality.

An important aspect of learning besides the media is the learning model. Learning is still teacher-centered so that students are passive in the learning process [6]. ICM (Index Card Match) type active learning model can be used so that the learning process is student-centered. The active learning model type ICM (Index Card Match) is a learning model that is used to test students' understanding of the material being taught by recalling the material by looking for pairs of question and answer cards that match and applying the concept of learning in a fun atmosphere. The ICM (Index Card Match) type active learning model can create an active and fun learning atmosphere, the material is easier to understand, learning is more varied, and can improve student learning outcomes [7]. Based on the theory from [8 & 9] regarding the ICM type active learning model, the components in ICM learning are 1) introduction, 2) index, 3) card, 4) match, and 5) discussion. These components must exist in the learning process with the ICM model so that learning takes place effectively.

Effective learning can improve student learning outcomes. Learning outcomes are achievements in the last stage of an educational process to acquire knowledge, skills, and the formation of attitudes [10]. Based on the results of observations made by [11] regarding student learning outcomes in the light wave material at MAN 1 and 2 Bekasi, it shows that 65% of students at these schools get daily physics test scores of less than minimum completeness criteria. Using the right media and learning models can improve student learning outcomes, especially in the material of light waves. As for indicators of increasing student learning outcomes according to [12], that is, with fulfillment The four elements that are required for learning to occur include students, educators, learning resources, and the environment. The use of android application-based learning media has a great influence on student learning outcomes [13]. The Index Card Match (ICM) learning model can also improve student learning outcomes [7]. The combination of Android-based learning media and the Index Card Match (ICM) learning model is expected to improve student learning outcomes.

Based on the description and problems above, the purpose of this research is to develop a physics learning application based on Index Card Match (ICM) on light diffraction material that is suitable for use by high school students.

II. METHOD

This research is a development research that uses the 4D research method. The 4D research stages in this study are the Define, Design, Development, and Dissemination stages. This research only reaches the Development stage because this research aims to determine the feasibility of the learning media to be developed.

The first stage is the define or defining stage. The focus in this stage is on the analysis of the formulation of the problems that occur, and determining the criteria, goals and limitations of the learning media to be developed. This stage is carried out by studying the literature on previous research. Based on the literature study on previous research, it is necessary to develop learning applications based on active learning type ICM on light diffraction material to create an active and fun learning atmosphere, the material is easier to understand, learning is more varied, and it can improve student learning outcomes. Learning applications to be developed must fulfill eligibility indicators, including conformity with basic learning competencies, support lesson content, ease of navigation, and has good technical quality. Table 1 shows the basic learning competencies that will be achieved through this application.

Table 1. Basic Learning Competencies

No	The Basic Learning Competencies
3.10	Applying the concepts and principles of sound and light waves in technology.

The next stage, namely the design or planning stage. This stage has an output in the form of a blueprint or blueprints for learning applications that are developed. The process in this stage, namely compiling content in applications that are tailored to existing competencies.

The content in learning applications consists of learning content, visual displays, and learning process schemes according to the ICM type active learning syntax. This stage is followed by compiling an application feasibility test instrument in the form of a questionnaire. The results of the design stages are as follows.

Table 2. Learning Content

No	Material
1	Definition of light diffraction
2	Single Slit Diffraction
3	Diffraction on a Lattice
4	Examples of Light Diffraction inEveryday Life

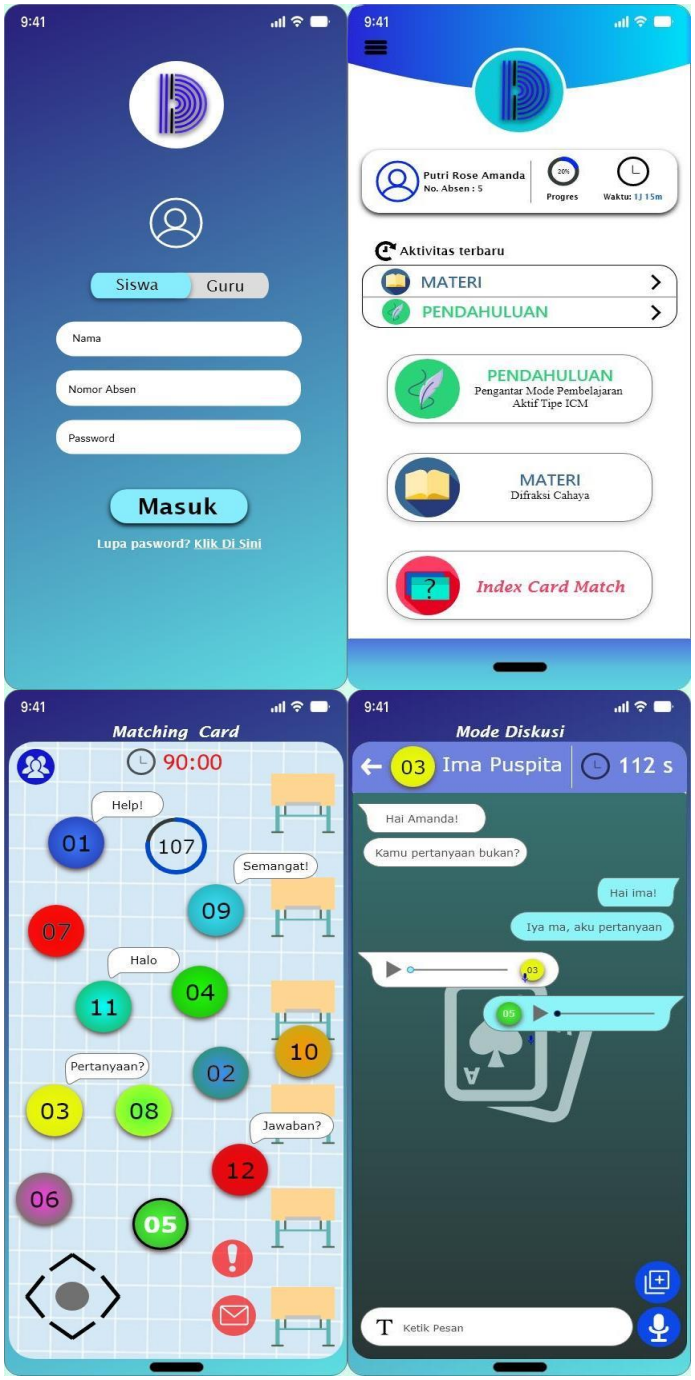

Fig.1. *DOptik* Application Design

Table 3. Syntax of the ICM type active learning model

Steps	Activity
Introduction	Provision of learning materials
Index	Formulation of questions and answers according to thelearning material
Cards	Each student gets one of the questions or answers.
Match	The process of students looking for pairs of questions andanswers they have.
Discussion	Students discuss with each other to be able to match answers and questions and to draw conclusions from the material beingstudied.

(Source: Ref [8 & 9])

The development stage is in the form of a feasibility test of the learning application blueprint by 24 students who are currently studying physics at several universities in Indonesia. The feasibility test is carried out to determine the feasibility of the learning application blueprint to be developed.

Table 4. *Doptik* application due diligence questionnaire

Indicator	Statement
Conformity with learningobjectives	1. The light diffraction material provided by the DOptik application isin accordance with the basic competencies of learning.
Support lesson content	2. The DOptik application contains complete, systematic, coherent,logical flow, clear, and easy to understand material.
	3. The questions and answers given by the DOptik application are inaccordance with the light diffraction material.
Ease of navigation	4. The DOptik application provides clear instructions for use.
	5. The DOptik application fulfills the communicative element, according to the message, and can be received according to the wishes of the target.
Technical quality	6. The language used by the DOptik application is in accordance withPUEBI rules.
	7. The visual graphics displayed by the DOptik application fulfill thebasic competency elements of learning, are clear and interesting.
	8. The images displayed by the DOptik application support thematerial presented.
ICM type active learning	9. The DOptik application fulfills the active learning indicators of theICM type.
Learning outcomes	10. The DOptik application can improve student learning outcomes onlight diffraction material.

The results of the feasibility test questionnaire from the blueprint of an active learning-based physics learning application were then analyzed by changing the form of the questionnaire data which was originally ordinal to interval using the Successive Interval Method (MSI). The results of the interval data were then analyzed using the Ideal Assessment Criteria on a scale of 4 by [14].

Table 5. Ideal Assessment Criteria Scale 4

No	Score Range	Quality Category
1	$X > Xi + 1{,}8\ SBi$	Very Feasible
2	$Xi + 0{,}6\ SBi < X \leq Xi + 1{,}8\ SBi$	Feasible
3	$Xi - 0{,}6\ SBi < X \leq Xi + 0{,}6\ SBi$	Not Feasible
4	$Xi - 1{,}8\ SBi < X \leq Xi - 0{,}6\ SBi$	Very Not Feasible

(Source: Ref [14])

The variable is the average final score of the indicator interval, and is the ideal average of the indicator interval which can be found using the equation = ½ (ideal highest score + ideal lowest score). The variable is the ideal standard deviation which can be found by the equation = ⅙ (ideal highest score - ideal lowest score).

III. RESULTS AND DISCUSSION

The blueprint feasibility test data for the light diffraction learning application based on active learning of the Index Card Match (ICM) type obtained through a questionnaire filled out by the examiner is ordinal data. The ordinal data is converted into interval data. The ideal score on each category of assessment with reference to the ideal scale of 4 rating criteria by [14] is shown in Table 6. The results of the due diligence data analysis of the *DOptik* application blueprint of each indicator after the data is converted to interval data are shown in Table 6.

Table 6. Ideal Assessment Category scale 4

Ideal Score	Quality Category
>3,4	Very Feasible
2,9-3,4	Feasible
2,3-2,8	Not Feasible
1,6-2,2	Very Not Feasible

Table 7. Results of Questionnaire Analysis

No	Indicator	X	Category
1	Conformity with learning objectives	4,271	Very Feasible
2	Support lesson content	4,324	Very Feasible
3	Ease of navigation	3,936	Very Feasible
4	Technical quality	4,093	Very Feasible
5	ICM type active learning	3,936	Very Feasible
6	Learning outcomes	4,011	Very Feasible

Data from the due diligence analysis results from the *DOptik* application blueprint show that the application developed is included in the very feasible category on all indicators. The results of the due diligence analysis indicate that the *DOptik* application blueprint meets all feasibility indicators and can be further developed into learning applications.

Indicator 1 is the suitability of the light diffraction material in the *DOptik* application with the learning objectives, namely the basic competencies in Table 1. The results of the analysis of this indicator show a final score of 4.271 which is included in the very feasible category. These results indicate that the *DOptik* application isin accordance with the basic competencies in light diffraction learning for high school students.

Indicator 2 concerns the material in the application *DOptik* support lesson content. This indicator has an average final score of 4.324 and is included in the very decent category. This indicator has the highest score of the other indicators. This indicator contains 2 items with the final score for each item shown in the graph in Figure 2.

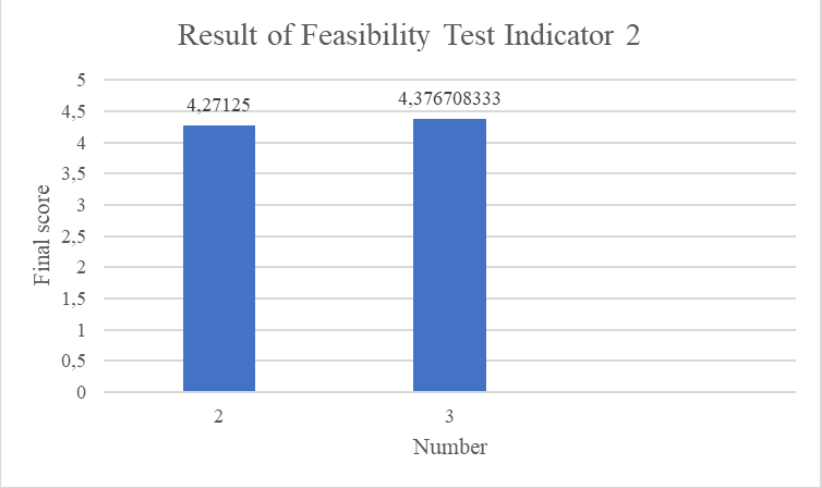

Fig.2. Result of Feasibility Test Indicator 2

The graph of the results of the feasibility test for indicator 2 in the figure shows that the *DOptik* application has supported the content of the Light Diffraction lesson. The *DOptik* application contains material on Diffraction of Light in a complete, systematic, coherent, logical, clear, and easy-to-understand manner. The questions and answers on the ICM card are in accordance with the Light Diffraction material. The delivery of light diffraction material in a coherent manner makes it easy for students to understand the material, this is in accordance with the respondent's statement. Table 2 shows the contents of the *DOptik* application material.

Indicator 3 is the ease of navigation with an average final score of 3.396. This score is included in the very feasible category. This indicator has 2 statement items with the final score of each item shown in Figure 3.

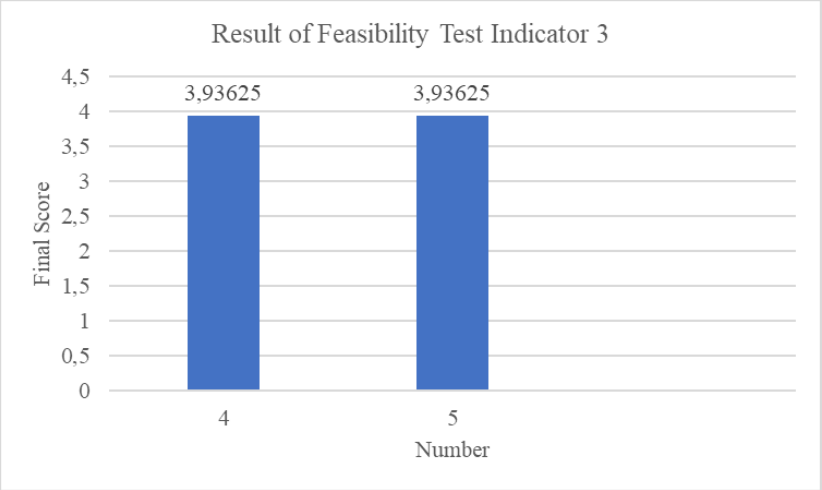

Fig.3. Result of Feasibility Test Indicator 3

The two statement items on indicator 3 are included in the very feasible criteria. This means that the *DOptik* application has provided clear instructions for use and fulfills communicative elements, according to the message, and can be received according to the wishes of the target. This can help students and teachers avoid confusion, such as a statement from one of the respondents regarding the use instructions.

Indicator 4 is technical quality which has an average final score of 4.093 and is included in the very feasible category. This indicator has 3 statement items, with the score of each item shown in Figure 4 below.

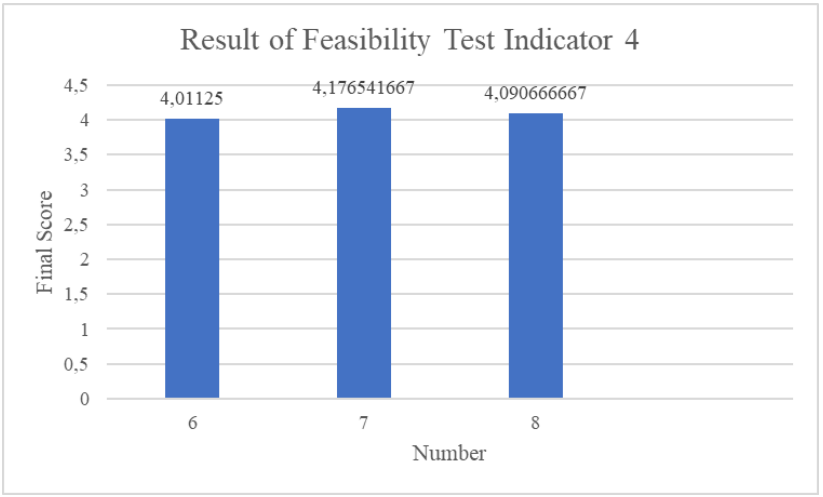

Fig.4. Result of Feasibility Test Indicator 4

The three statements in indicator 4 are included in the very feasible criteria. These results indicate that in general *DOptik* applications use language that is in accordance with PUEBI rules, the visual graphics displayed fulfill the elements of learning objectives, are clear and attractive, and the animations and images displayed by the application support the material presented. The visual aspect of the graphics must be improved again. The quality of some images in the *DOptik* application is still low because it has a low resolution.

Indicator 5 is the learning model used, namely the active learning model of the Index Card Match (ICM) type. This indicator has a score of 3.936 which is included in the very feasible category. These results can be

interpreted that the *DOptik* application has fulfilled the indicators of the ICM type active learning model. Indicators of the ICM type active learning model include 1) introduction: Giving learning material, 2) Index: Formulation of questions and answers according to learning material, 3) card: Each student gets one of the questions or answers, 4) Match: Student process look for each other's pairs of questions and answers, and 5) Discussion: Students discuss with each other to be able to match answers and questions and to draw conclusions from the material being studied. [6] stated that the problem with students when learning is their passivity. This is also reinforced by a statement from [15] that learning physics in class is still teacher centered using conventional methods which makes students bored and becomes ineffective which also affects their learning outcomes. The results of the feasibility test on this indicator prove the feasibility of the ICM type active learning model in the *DOptik* application as a learning model in physics to improve student learning outcomes.

Indicator 6 is learning outcomes with a final score of 4.011. This score is included in the very feasible category. The results mean that the *DOptik* application can improve students' cognitive learning outcomes in the Diffraction of Light material. These results indicate the feasibility of the *DOptik* application as a learning medium for Light Diffraction material, so that it can overcome the problems of physics teachers, namely the difficulty in finding learning media that can improve student learning outcomes.

The average final score from the results of the due diligence analysis of the *DOptik* application blueprint is 4.095 which is included in the very feasible category. The *DOptik* application blueprint has met the eligibility standards for all aspects including as a learning medium, implementation of the ICM type active learning method, and can improve student learning outcomes. The *DOptik* application has been packaged in an attractive and appropriate learning objective and presents material in a complete, systematic, coherent, logical flow, clear, and easy to understand. The *DOptik* application is also in accordance with the active learning syntax of the Index Card Match type so that students can learn more actively and effectively. This is in accordance with the statement of [7], that the advantages of the ICM (Index Card Match) model are the creation of an active, fun, learning atmosphere. and make learning less boring or more varied, and students become more careful. [4] argues that learning media in the form of mobile applications, one of which has the Android operating system, is one of the portable learning media so that the *DOptik* application is expected to be used as a learning medium to assist physics teachers in the learning process on light diffraction material in post covid-19 pandemic (new normal) as it is today. It is necessary to develop this application blueprint into an application that is ready for use by students and applications can be developed at other materials and levels.

The results of the feasibility test of the *DOptik* application blueprint show that the *DOptik* application is very feasible to use as a medium for learning physics in light diffraction material for high school level with several revisions according to theory.

IV. CONCLUSION

The results of this study indicate that the *DOptik* application blueprint based on active learning Index Card Match (ICM) type meets the feasibility indicator, with an average final score of 4.01. These results are in a very feasible category based on the ideal rating criteria scale 4. Blueprint application of *DOptik* as an active learning-based optical learning medium for the Index Card Match (ICM) type is very suitable for use in the physics learning process on Light Diffraction material to improve school student learning outcomes of senior high school.

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REFERENCES

[1] N. Reno and E. Malik, "Pengembangan Virtual Lab Gelombang Cahaya Untuk Pembelajaran Aktif Dan Kemandirian Belajar Di Era New Normal" pada *Lomba Karya Tulis Ilmiah*, 2021, pp. 1-14.

[2] A. Nur. "Studi Pendahuluan Pengembangan Aplikasi Mobile Learning Berbasis Android Dengan Menggunakan Adobe Flash Cs6 Untuk Materi Bunyi Dan Cahaya" pada *Prosiding Seminar Nasional Fisika (E-Journal)*. vol. 9, 2020.

[3] F. Fatmawati, Y. Yusrizal, and A. M. Hasibuan. "Pengembangan media pembelajaran berbasis aplikasi android untuk meningkatkan hasil belajar IPS siswa", *Elementary School Journal Pgsd Fip Unimed.*, vol. 11, no. 2, pp. 134-143, 2021.

[4] M. Matsun, D. Ramadhani, and I. Lestari. "Pengembangan bahan ajar listrik magnet berbasis android di program studi pendidikan fisika IKIP PGRI Pontianak" *Jurnal Pendidikan Matematika dan IPA*., vol. 9,

no.1, pp. 99-107, 2018.
[5] S. Hujair, *Media Pembelajaran Interaktif-Inovatif*. Yogyakarta : Kaukaba Dipantara, 2013.
[6] S. Ahmad, and S. Malinda, "Identifikasi Kendala Siswa dalam Proses Pembelajaran Bounded Inquiry Lab pada Konsep Difraksi Cahaya", *Berkala Ilmiah Pendidikan Fisika*., vol. 6, no. 3, pp. 315-324, 2018.
[7] Anggraeni and U. Zuhdi, "Pengaruh model pembelajaran kooperatif tipe icm (index card match) terhadap hasil belajar siswa materi kegiatan ekonomi berdasarkan tempat tinggalnya kelas iv sdn babatan 1 surabaya", *Jurnal Penelitian Pendidikan Guru Sekolah Dasar.*, vol. 5, no. 3, 2017.
[8] R. Muttaqien, *Active Learning 101 Cara Belajar Siswa Aktif*. Bandung : Nusamedia, 2009.
[9] Istarani, *58 Model Pembelajaran Inovatif*. Medan: Media Persada, 2011.
[10] Fatmawati and Yusrizal, "Peran Kurikulum Akhlak dalam Pembentukan Karakter di Sekolah Alam Sou Parung Bogor", *Jurnal Tematik.*, vol. 10, no. 2, pp. 74-80, 2020.
[11] A. Pratama, "Pengaruh Model Pembelajaran Aptitude Treatment Interaction terhadap Hasil Belajar Siswa pada Konsep Gelombang Bunyi dan Cahaya," *Bachelor's thesis*. FITK UIN Syarif Hidayatullah., Jakarta, 2020.
[12] S. V. L. Perdana and B. T. Siswanto, "Faktor-faktor yang mempengaruhi hasil belajar siswa pada pembelajaran praktik kelistrikan otomotif SMK di Kota Yogyakarta", *Jurnal pendidikan vokasi*., vol. 6, no. 1, pp. 111-120, 2016.
[13] P. R. Suhendar, N. Wijayati, and F. W. Mahatmanti, "Pengaruh penggunaan media pembelajaran berbasis aplikasi android terhadap hasil belajar siswa", *Jurnal Inovasi Pendidikan Kimia*., vol. 11, no. 2, 2017.
[14] W. E. Putro, *Evaluasi Program Pembelajaran*. Yogyakarta : Pustaka Pelajar, 2017.
[15] Dewi, "Upaya meningkatkan minat dan hasil belajar peserta didik melalui kegiatan praktikum berbasis aplikasi smartphone pada materi gelombang bunyi," *Doctoral dissertation*. UIN Sunan Gunung Djati., Bandung, 2020.