Developing of *Discon* E-Module Based on Android in Force and Motion Material

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Abstract

The problem in this study is that the Learning media is quite limited and less interesting. The difficulty of teachers controlling the online learning process during the pandemic. The purpose of this research is to develop a science practicum e-module with a valid and practical Android-based discovery learning approach. This research is research and development with the Borg and Gall model. The 5 stages of this research are preliminary research and analysis, developing initial products, expert validation and revision, small-scale field trials and product revisions, and large-scale field trials. The research instrument used interviews and media validation questionnaire sheets, material validation , and user validation. This study was conducted on a small scale where the subjects were class teachers and 6 students of Grade IV SD Muhammadiyah 1 Palu. Based on the results of data analysis obtained material validity values of 23, 12, 9, 11, and 12 with a very strong Category. user (student) satisfaction respectively 91.7, 88.3, 96.7, and 86.7 7, and user (teacher) satisfaction of 90, 70, 100, and 100 with very good category. So it can be concluded that the Android-based E-module discon (E-module DISROID) developed in the criteria is very valid and practical. So that this module can be used in science learning, especially for practicum activities in Grade IV of elementary school.

Keywords: Discovery Learning, E module, Science practicum, Science Learning.

Pengembangan Discon E-Modul berbasis Android pada materi Gaya dan Gerak

Abstrak

Permasalahan dalam penelitian ini yaitu media pembelajaran yang terbilang cukup terbatas dan kurang menarik. Kesulitan guru mengontrol kegiatan pembelajaran daring selama masa pandemi. Tujuan penelitian ini guna mengembangkan e-modul praktikum IPA berpendekatan discovery learning berbasis Android yang valid dan praktis. Penelitian ini merupakan penelitian dan pengembangan dengan model borg and gall. 5 tahapan penelitian ini yaitu: penelitian pendahuluan dan analisis, mengembangkan produk awal, validasi ahli dan revisi, ujicoba lapangan skala kecil dan revisi produk, dan ujicoba lapangan skala besar. Instrumen penelitian menggunakan wawancara dan lembar angket validasi media, validasi materi serta validasi pengguna. Penelitian ini dilakukan dalam skala kecil dimana subjeknya adalah guru kelas dan 6 orang siswa kelas IV SD Muhammadiyah 1 Palu. Berdasarkan hasil analisis data diperoleh nilai validitas materi yaitu 23, 12, 9, 11, dan 12 dengan kategori sangat kuat. Adapun validitas media adalah 84 . kepuasan pengguna (siswa) masing-masing sebesar 91,7, 88,3, 96,7, dan 86,7 7 dan kepuasan pengguna (guru) sebesar 90, 70, 100 dan 100 dengan kategori sangat baik. Sehingga dapat disimpulkan bahwa e-modul discon berbasis android (E-Modul DISROID) yang dikembangkan masuk pada kriteria sangat valid dan sangat praktis. Sehingga modul ini dapat digunakan dalam pembelajaran IPA khususnya dalam kegiatan praktikum di kelas IV sekolah dasar.

Keywords: *E module, Android, Praktikum IPA, Pembelajaran IPA*

INTRODUCTION

The existence of the Industrial Revolution 4.0 can be seen from several fundamental changes. These changes include changes in basic technology, social, macroeconomic and others. The characteristics of the Industrial Revolution 4.0 include Artificial Intelligence or known as artificial intelligence, I Cloud data, Internet of People, Big Data, Internet of Things (IoT) and Digitalization, where all these new developments have caused disruption in various fields of human life, including the field of education (Afrianto, 2018).

The education sector, which is one of the main pillars for the further development of the nation's next generation, must also adapt to the times so that it is not left behind from developed countries both in terms of educational technology and curriculum when compared to developed countries. The new era of Industry 4.0 will bring major changes to the physical world, such as virtual facilitation made possible by digital connections, shortening distances, eliminating inequalities, and transferring information and materials in real time around the world.(Umachandran et al., 2018). This has also been proven at a time when almost all corners of the world were attacked by the corona virus. Where, the pandemic that hit the world including Indonesia has forced all elements of society to work from home by utilizing technology. One that is very prominent is the education sector, both at the primary, secondary and tertiary levels, must carry out online learning to break the chain of spreading the covid-19 virus. About 30% of the world's population has used social media to communicate, find information and learn. (Balatsky, 2019).

The Covid-19 pandemic has brought enormous changes in the implementation of education, especially in teaching and learning activities. (Febri et al., 2022). The covid-19 pandemic is certainly a time when technology is needed. Where, all access to education is carried out online, both the teaching and learning process and the assignment process. Of course, this is a challenge for education actors, especially teachers, who must be able to provide interesting learning by utilizing existing digital developments.

This condition is very necessary for innovation and adaptation related to the use of existing technology to support learning. (Ahmed et al., 2020). In practice, teachers and students are required to communicate and share information online. According to (Elfrianto et al., 2020) hrough online learning models, students can receive learning because online learning models are more relaxed, more fun, more flexible, more efficient, more concise, more practical, faster, more accurate, safer, easier, and more time-saving. You can learn from afar, without meeting in the same place. Besides these advantages, online learning also has disadvantages. Students find it difficult to concentrate on learning because of the unconducive atmosphere at home.f (Sitepu, dkk., 2022). Online learning can utilize platforms such as applications, websites, social networks and learning management systems. (Gunawan1*, Ni Made Yeni Suranti2 & 1Physics, 2020). Asmurti et al., 2017 found that the use of smartphones by students is considered capable of improving student learning outcomes in the learning process. This can provide opportunities for teachers to develop ICT-based interactive media or teaching materials

One of the learning media that utilizes ICT and is considered capable of being one of the solutions during a pandemic is e-modules. Herdiana & Hunaepi, 2016 defines E-modules as learning tools that contain material, method limitations and evaluation in an electronic system to achieve the expected learning objectives. In addition Wijayanti et al., 2016 said that E-modules are digital or non-print teaching materials that are arranged systematically which

are used for self-study in a way that requires students to learn to solve problems in their own way.

Furthermore, Samiasih et al., 2013 , it defines E-modules as computer modules that contain components and questions in each component to make it easier for users to understand the material. Electronic modules or e-modules are defined as learning environments that use computers to display text, images, graphics, sound, animation and video in the learning process. (Annisa & Sari, 2021).

Observations of online and offline learning activities during the pandemic have also been carried out by researchers. The results of the interview with the fourth grade teacher of SD Muhammadiyah 1 Palu obtained preliminary data that during the distance learning (PJJ) period caused by the Corona virus outbreak, learning was carried out by utilizing the WhatsApp application and the Zoom Meating application. Teachers also admit to experiencing difficulties in implementing online learning due to the difficulty of controlling students directly and the difficulty of students in understanding the material conveyed by the teacher..

Force and motion material is learning material contained in the learning curriculum in elementary school, precisely in grade IV elementary school. The material of force and motion in science learning itself requires direct practice even though it uses simple media. According to information obtained by researchers from the fourth grade teacher of SD 1 Muhammadiyah regarding the practice that teachers and fourth grade students have done. Teachers and students have only ever done one simple experiment where the practice was carried out during face-to-face learning not online or online. The practice that teachers and students have done is to conduct simple experiments on the material of force and motion, where teachers and students carry out activities to kick the ball. This practice was carried out in the classroom using media and materials in the form of student books and balls.

The solution obtained by researchers from the above problems is to use android-based e-modules. Android-based e-modules can facilitate teachers in the learning process, support the use of electronics as a learning medium, and even facilitate students in learning and practicing independently.

This android-based e-module itself is a development of printed modules. The printed module here is a science practicum module using discovery learning (discon module). The discon module is the idea of learning media that can be studied independently which includes learning objectives, material summaries and practical activities to witness natural phenomena. Practical activities involve a series of questions that require students to use science process skills, namely observation, measurement, communication, classification, prediction, and perturbation/hypothesis. Students can draw their own conclusions from the material learned through exercises and search for answers to questions. (Thalib et al., 2020). Therefore, researchers plan to develop printed modules into Android-based discount modules (Disroid-e-module) to facilitate student and teacher activities because they are easier to carry around and can be used anywhere.

The Discovery Learning Science Training Module is a self-directed learning environment that includes learning objectives, material summaries and hands-on activities to demonstrate natural phenomena. Appropriate activities include a series of problems that require students to develop skills in the scientific process, namely observation, measurement, communication, classification, prediction and perturbation/hypothesis. (Azizah & Fajeriah,

2021). Through practicum activities and the process of finding out the answers to the questions presented, students can make their own conclusions about the material they learn.

METHODS

This research is a Research and Development (R&D). Gall et al., in Arikunto, 2010 suggests that development research is an effort to develop and validate products that will be used in education. Borg and Gall in Utomo et al., 2016 said that in research and development, the stages are a cycle in the form of a review of research findings in the field related to the product to be developed. Gall et al., 1996 states that the development research procedure has 10 steps, namely
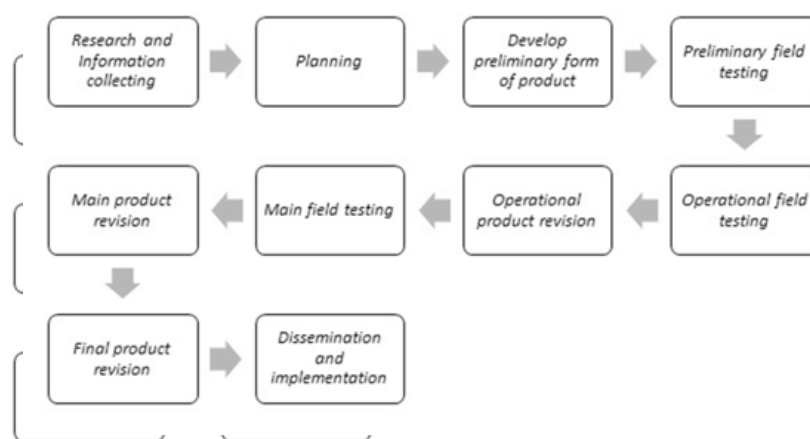

Figure 1: Development Research Stages by Borg and Gall

Phase I (preliminary research)

Research and development always starts with knowing the potential and problems in the field. Initial research or observation was conducted by interview and direct observation in class IV SD Muhammadiyah 1 Palu to determine the level of student learning success in science subjects based on the predetermined KKM. Observations were also carried out to find out what kind of learning media and learning practices have been carried out by teachers and students in the science learning process, especially on the material of force and motion. At this stage, the process of analyzing the curriculum and teaching materials in science subjects is also carried out. On the curriculum of science lessons in grade IV, especially on the material of force and motion

This stage, researchers also collect data and information that are expected to be useful for planning research products. The data collection method used is tailored to the problems and research needs. At this stage the researchers collected data using interviews and questionnaires. design of problem formulation and research objectives. Where the problem was found that Muhammadiyah 1 Palu Elementary School was still lacking in terms of learning media. Then the researcher designed an android-based media. Which is then expected that the android-based media can be Valid and Practical for students to use in elementary schools.

Phase II (initial product development)

This stage is the phase of making module and application designs. The design is made by adjusting and paying attention to the needs of students and teachers in science subjects. In this phase, sketches of interactive module and application designs and application work diagrams were made. The following things are done in this phase:

1) Collecting product needs. At this stage researchers collect all the needs to develop interactive modules and supporting applications, such as module cover images and application icons, module material sources, application logo images
2) Sketching the product display and application worksheets. This stage is carried out by referring to the product design composition that has been compiled at the product needs analysis stage.
3) Determine the dateline. Deadlines are set so that the design and development of interactive modules goes according to plan.
4)

Phase III (Design validation).

This validation stage is the editing stage carried out by material experts and media experts. at this stage the researcher can also find out whether the teaching material in this case is in the form of a discon e-module developed in the form of an android-based application (e-module Disroid) is more attractive than the previous product. At this validation stage, researchers are also expected to get input and suggestions for making design improvements.

Design improvements are made in accordance with the input and suggestions provided by material experts and media experts through questionnaires. Improvements made at this stage are initial improvements before testing the product. Improvements are made based on the results of validation that has been carried out by experts/experts so that weaknesses will be found.

Phase IV (product small-scale trial)

This stage is the product sampling stage carried out in the learning process. This trial is useful to determine the practicality of the Android-based discount e-module application (Disroid E-Module) used in learning grade IV elementary school students. The field test was conducted on a limited scale or in a small group of 6 people randomly selected as subjects. At this stage data can be collected and analyzed through interviews, observations and questionnaires.

Phase V (product revision)

Based on the results of the product test, it can be said that if the product given is valid and practical in the answers of teachers and students, then it can be said that the educational material has been developed. and the result is the final product. However, if the product is not perfect, the results of this test will be used as material to improve and perfect the educational materials to be produced to get an attractive final product that can be used in schools.

Data collection techniques in this development research used interviews, observations and questionnaires. Data collection is carried out to obtain data and information that will be used for data analysis. Interviews and observations provide information in the phase of knowing the potential and problems of development, while questionnaires are needed to collect validity evaluation data from experts and module users, namely students and teachers.

The material expert instrument is used to determine the quality of the material and the benefits of interactive modules with augmented reality technology as an educational tool in the implementation of electronic components. There are several aspects that must be evaluated in the Material Expert tool. These aspects are: self instructional, self contained, stand alone, adaptive, user friendly aspects. (susilana, rudi dan riyana, 2008). Instruments for media experts are used to determine the level of media feasibility. Media feasibility assessment is seen from two aspects, namely: system quality and data quality. User-oriented instruments are used to

determine the feasibility level of field media in terms of material and media. Aspects of assessment on user instruments include effectiveness, efficiency, overall satisfaction and ease of use.

Descriptive analysis techniques were used to analyze the data in this developmental research. The descriptive analysis included measures of central tendency, reliability, frequency distribution and data classification. Central tendency measures are statistical measurement techniques that provide a single score such as the center of the distribution. Some methods commonly used to measure central tendency are: mean (average value), median (average value), mode (frequently occurring value). The method used as the central tendency in this development study is the mean. The average of a data set can be determined using the following formula.

$$P = \frac{x}{xi} x 100\%$$

With the information P is the percentage, x is the score obtained, and xi is the maximum score of the criteria

Classification of information obtained from data analysis in the form of quantitative data is converted into qualitative data by grouping scores into score intervals. This step is done to determine the score interval from the analysis results. At the data classification stage, a conversion table was used in this development research, namely a conversion table for product validation tests and product trials. The following is a table used in the classification of research materials.

Table 1. **Feasibility Conversion Table for Product Validation Tests and Product Trials**

Interval Skor	Kategori
X ≥ (x + 1.SBx)	Very Worth it
(x+1.SBx) > X ≥ x	Worthy
x > X ≥ (x-1. SBx)	Not feasible
X < (x – 1.SBx)	Very Unworthy

(Mardapi, 2018)

X is the score obtained from the research, x is the overall score average (½ ideal max score - ideal min score), SBx is the overall standard deviation (1/6 ideal max score - Ideal min score).

RESULT AND DISCUSSION

Based on the development process that has been carried out using the Borg and Gall model, the following results are obtained

Preliminary research and analysis stage

This stage is the first step to formulate existing problems from the actual conditions in the field. The initial research and data analysis stages are:

Curriculum analysis

After conducting an interview process with the fourth grade teacher of SD Muhammadiyah 1 Palu, it is known that the education system in this school uses the 2013 curriculum. In the curriculum of science lessons in grade IV, especially in the material of force and motion has 4 basic competencies, namely: 3.3 identify various kinds of forces, including: muscle force, electric force, magnetic force, gravitational force and friction force. 4.3

demonstrate the benefits of forces in everyday life, such as electric force, magnetic force, gravitational force and frictional force. 3.4 relate force to motion in events in the surrounding environment. 4.4 present the results of an experiment on the relationship between force and motion.

Problem analysis

From the interview process conducted during the observation, the researcher found that during the learning process, both offline and online, the teaching media used were only printed books. During offline learning, teachers and students conducted one simple practice in the classroom and the media used was still fairly simple. Namely, only in the form of textbooks and balls, no teaching materials that utilize technology have been found.

Needs analysis

Learning in the classroom so far only utilizes existing printed books. So that students find it difficult to access material when outside of school hours. Based on the results of a survey conducted by introducing the Disroid application for the first time, there was quite high enthusiasm shown by both teachers and students. This application is quite interesting for students because the content is packaged as interesting as possible and makes it easy for students to learn anytime and anywhere.

Initial product development stage (design).

Product Needs

E-modules are made by selecting components that will be used starting from fonts, font sizes, covers and backgrounds, images, videos, materials, experimental activities, to evaluation questions. The use of fonts in the discon e-module uses Comic Sans MS fonts and Arial fonts with font sizes tailored to the needs of the application display. The materials, experimental activities, and evaluation questions contained in the e-module discon force and motion material are various forces, the benefits of force, and the relationship between force and motion. The evaluation questions totaled 30 questions consisting of 20 multiple choice questions and 10 essay questions.

E-modules are made by selecting the components to be used, starting from fonts, font sizes, covers and backgrounds, images, videos, materials, test activities to assessment questions. The font types used in the discon module are Comic Sans MS font and Arial font, and the font size is adjusted to the needs of the application screen display. The e-module includes force and motion material, namely various forces, the benefits of force, and the relationship between force and motion. The assessment questions totaled 30 questions consisting of 20 multiple choice questions and 10 essay questions

E-module Framework

In E-module Discount, users must log in first to be able to access it. Discount e-module users are divided into two groups, namely teachers and students, so users are expected to log in according to their profession. Teacher and student users will automatically connect to each other. In order for student users to access materials, assessment questions, and other features, they must enter the class code provided by the teacher user.

The creation of the discon e-module framework generally consists of three main parts, namely learning activities, multiple choice assessments and essay assessments. The learning

process is in the form of KD, KI, learning objectives, concept map, description of force and motion material, experimental activities, summary, glossary and bibliography. Here are some examples of the e-module framework developed.
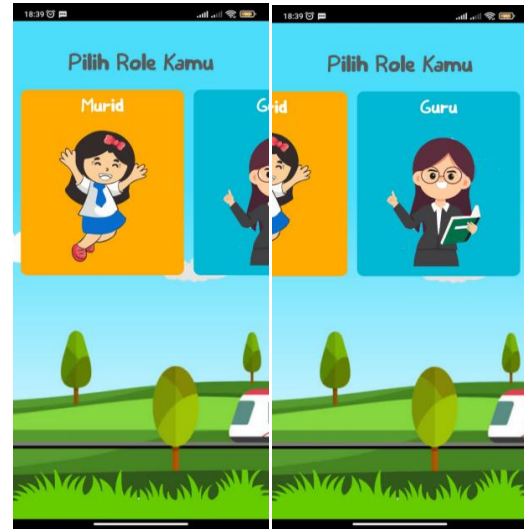

Figure 2. Initial view of the Discon e-module

Figure 3. Role view in the application

Figure 4. Display of experiment activities on force and motion material on the discon emodule
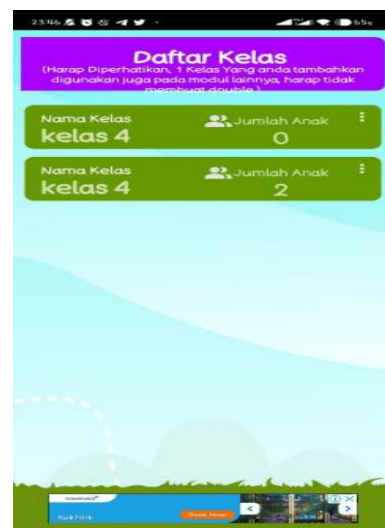

Figure 5. Class view on teacher user

Figure 6: Display of multiple choice evaluation questions

figure 7. Display of essay answers that students have done

Expert validation and revision stage.

The assessment instrument is a questionnaire distributed to media experts, material experts and users who are then filled in based on the suitability of the existing discount application. Validation is carried out by media experts and material experts to determine the feasibility level of the discount application before it is used by users and to then make revisions as necessary to perfect the application. The results of the validation of media experts and material experts say that this application is feasible and valid to then be tested directly on teachers and students to determine the level of practicality of the discount application.

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Product Trial Stage

After the validation test stage is complete and the results say that the e-module discon is valid based on the results of validation by media experts and material experts. Then it will be tested to users, namely teachers and students. The trial of the android-based e-module discon (e-module disroid) was conducted in class IV of SD Muhammadiyah 1 Palu. Where this trial was conducted together with 1 fourth grade teacher and 6 fourth grade students of SD Muhammadiyah 1 Palu.

User trials were conducted offline. Teacher and student user product trials were conducted on the same day. After testing the android-based e-module discon (e-module disroid) teachers and students together fill out a user response questionnaire to determine the practicality value of the android-based e-module discon (e-module disroid) force and motion material.

Validation of the e-module discon involved two validators, namely Mrs. Ir. Hajra Rasmitha Ngemba, S.Kom., M.Kom., MM. who is a lecturer in Informatics Engineering at Tadulako University as a media expert validator and Mrs. Nurul Kami Sani, S.Pd., M.Pd. who is a lecturer in the field of science, PGSD study program at Tadulako University as a material expert validator. The results of the presentation of validation data from validators are as follows:

Material Expert Validation Results

The development of e-module discon force and motion material that has been developed, then validated by a material expert validator a science lecturer in the PGSD study program at Tadulako University. This validation process aims to assess the feasibility of e-module discon force and motion material in terms of material, language and presentation. The validation process was carried out once and the results obtained were feasible for the use of e-module discon force and motion material. The results obtained from material experts are as follows

Tabel 2. The results of the media and user validation assessment

Aspek penilaian	Nilai	Kategori
Self Instruction	95,8	Very Good
Self Contined	100	Very Good
Stand Alone	75	Good
Adaptif	91,7	Very Good
User Friendly	75	Good

Media Expert Validation Results

After being declared valid and feasible to use in terms of material, the next step is to validate the e-module discon product media of force and motion material. This validation was carried out by a media expert validator, namely Mrs. Ir. Hajra Rasmitha Ngemba, S.Kom., M.Kom., MM. He is a lecturer in Informatics Engineering, Faculty of Engineering, Tadulako University. This validation process aims to assess the feasibility of e-module media from the aspects of system quality and information quality. Media validation is done twice in order to get a product that is valid and feasible to use. The following are the results of media validation:

Table 3. Media and user validation assessment results

Indikator	Nilai	Kategori
System Quality	84	Very Good
Information Quality	84	Very Good

Based on the results of media expert validation for indicators of system quality and information quality, the score is 84 with a very good category. Although it has reached a very good category which means the product is worth testing to teachers and students. However, the validator still provides suggestions for improving the product, namely by adding other menus that can support the function of the application. Therefore, it is necessary to improve the product (application) to achieve a better level of feasibility.

E-modules that have been declared valid in terms of material and media, can be tested to users. User testing begins with small-scale testing. This small-scale trial was conducted by involving teachers and some students only. The subjects involved in this small-scale trial were the homeroom teacher and fourth grade students of SD Muhammadiyah 1 Palu. The results of the e-module discon trial on force and motion material are described in the following table.

Table 4. Practicality assessment results from users

	Indicator	Score	Category
Student	Effectivity	91,7	Excellent
	Eficiency	88,3	Excellent
	Satisfaction	96,7	Excellent
	Easy to use	86,7	Excellent
Teacher	Effectivity	90	Excellent
	Eficiency	70	Excellent
	Satisfaction	100	Excellent
	Easy to use	100	Excellent

The results of the practicality assessment shown in table 3 obtained that the practicality value of student users from effective, efficient, overall satisfaction and user-friendliness indicators were 91.7, 88.3, 96.7, and 86.7 respectively with very good categories. Meanwhile, the value of user practicality from effective, efficient, overall satisfaction and user-friendliness indicators is 90, 70, 100 and 100 respectively with very good categories. The acquisition of this value, means that if the e-module discon developed has entered the practical category. Thus, the e-module discon can be used in field trials or large-scale users. Therefore, the e-module discon force and motion material developed has entered the valid and practical category.

It is hoped that the e-module will become a new learning tool for students and can further improve students' concept understanding and learning outcomes. (Imansari & Sunaryantiningsih, 2017). EThe module provides a bridging solution that covers four aspects: scientific context, process, content and attitude. (Raharjo et al., 2017). The utilization of learning environments such as interactive e-modules in the learning process allows learning materials to be more interesting. (Fonda & Sumargiyani, 2018).

After conducting research at SD Muhammadiyah 1 Palu through filling out questionnaires and direct observation in the field, it is known that the advantages of the android-based discon e-module (e-module disroid) are as follows:

a) Increase student motivation, because each time working on learning tasks that are clearly limited and in accordance with abilities.
b) Students are more interested in learning the material because the application designed is very interesting starting from the preparation of material accompanied by images, applications accompanied by music and videos.
c) Applications that are accompanied by evaluations make students more excited and interested in working because students can see their scores directly.
d) It makes it easier for students to learn because the application can be accessed at home.
e) Teachers find it easier to conduct evaluations because the evaluation data can be downloaded automatically through the application.
f) Assist teachers and students in learning activities that are validated through tests, especially on force and motion material.
g) Students become more active and independent in conducting experiments.

However the research also found the disadvantages of the use discon e-module:

a) It is better if used in groups, because tests conducted in groups will produce diverse concepts.

b) Not all students are able to directly understand the experimental procedures in the module, for this reason it requires higher attention from the teacher to continuously monitor the student learning process, motivate and consult independently whenever students need it.

c) Android-based e-modules (disroid e-modules) cannot be used for all materials in science and other subjects.

d) The application still often experiences loading if it is in a less stable network connection.

e) Students can only access the application using the internet network.

CONCLUSIONS

Based on the results of research conducted in class IV of SD Muhammadiyah 1 Palu, the following results were obtained: 1). Android-based discon e-module (e-module disroid) on force and motion material for grade IV students of SD Muhammadiyah 1 Palu is included in the valid criteria. This is evidenced based on the results of the average validation of material experts in the aspects of self instruction, self contained, stand alone, adaptive and user friendly aspects obtained each value of 95.8, 100, 75, 91.7, 75 with very valid criteria. Likewise, the average value of media experts is 84 with very valid criteria. 2). Android-based discon e-module (e-module disroid) on force and motion material for grade IV students of SD Muhammadiyah 1 Palu is included in the practical criteria. This is evidenced by the average results of filling out questionnaires that have been carried out by students, it is obtained that the practicality value of student users from indicators of effectiveness, efficiency, overall satisfaction and ease of use is 91.7, 88.3, 96.7, and 86.7 respectively with very good categories. Meanwhile, the value of user practicality from effective, efficient, overall satisfaction and user-friendliness indicators is 90, 70, 100 and 100 respectively with very good categories. The acquisition of this value means that if the discon e-module developed has entered the practical category.

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