Thabiea : Journal of Natural Science Teaching
Vol. 3(2), pp. 79-94, 2020
Available online at
http://journal.iainkudus.ac.id/index.php/Thabiea
p-issn: 2580-8474, e-issn: 2655-898X

Developing Physics E-Module Using "Construct 2" to Support Students' Independent Learning Skills

Nurhasnah[1], Windy Kasmita[2*], Prima Aswirna[3], Firsty Indah Abshary[4]
[1,3,4]Department of Sciences-Physics, Faculty of Tarbiyah and Education
Universitas Islam Negeri (UIN) Imam Bonjol Padang,
Jl. Prof. Mahmud Yunus Lubuk Lintah, Padang 25153, Indonesia
[2]Science Education Departement, Postgraduate School, Universitas Pendidikan Indonesia,
Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia
**Correspondence: windykasmita01@gmail.com*

Keywords:
E-Module
"Construct 2"
Learning
Independence

Abstract

This research is an e-module development that aims to support students' learning independence. One of the causes of the students' low learning independence is the lack of teaching materials that can support the students' learning independence. The use of teaching materials and monotonous methods make students lazy and bored in learning so that it impacts the independence of learning. Research and development method of plomp models used in this study which consists of a preliminary research stage (Preliminary Research), the design phase or prototype (Development of Prototype phase), and the assessment phase. The research This research was conducted at a high school in the city of Padang class XI IPA. The validity test was given to 2 material expert lecturers, 2 media expert lecturers, and 1 linguist lecturer, and tested by 2 educators and 15 students for practicality, and 20 students for effectiveness. The results of this study are said to be very valid with a value of 90.66, very practical with a value of 94.5, and very effective with a value of 89.2. Based on data acquisition, it appears that the E-Module physics uses "Construct 2" to support the learning independence of students categorized as very valid, very practical, and very effective in learning physics.

To cite this article:
Nurhasnah, N., Kasmita, W., Aswirna, P., Abshary, F. I., (2020). Developing Physics E-Module Using "Construct 2" to Support Students' Independent Learning Skills. *Thabiea : Journal of Natural Science Teaching, Vol. 3(2)*, 79-94.

Introduction

The advancement of science and technology in various countries increased rapidly in the 21st century (Farisi, 2016). The rapid development of information and communication technology (ICT) brought about major changes in the field of education (Al-Tarawneh, 2014). The development of technology in education has resulted in many innovations to support the learning process (Malik, 2018). 21st-century learning requires learners to become increasingly self-reliant in learning and evolving to adapt to their day (Wibowo, 2014). The learning process can take place effectively by providing students with opportunities for independent study so that by conducting students ' learning activities can gain knowledge from their understanding (Rivers, 2017). Students who are independent in learning have the desire to go

forward for their good, able to make decisions and initiatives to overcome the problems faced, have confidence in doing tasks, and are responsible for what he does (Lubis, 2014).

Self-reliance Learning is also one of the traits in 21st-century learning (Bibbings, et.al 2018). The learning process can run well when learning activities are active in learners (Nurhasnah, 2017). Learners are required to be able to study independently, whether with or without the guidance of educators (Kopzhassarova, et.al 2016). Learners do not just come, sit, hear educators ' lectures, and memorize the material teachers provide, but instead strive independently to construct their knowledge (Bauziene & Vosyliute, 2014). To construct knowledge, learners can learn independently through collaboration with their friends (Field, et.al 2015) Besides, teaching materials should be designed so that students can relate lesson materials to everyday life, especially in physical learning (Tharmar & Kalidasan, 2019). Physics is one of the elements in the natural sciences which plays an important role in the development of science and Technology (Aswirna, 2017).

The effort to realize the learning of physics that can support the independence of students' learning can be done by developing digital teaching materials that utilize technology and communication (Jones & Dexter, 2014). The development of technological science is very possible for learners to repeat lessons at home. Educators are required to be able to develop a digital teaching material that can be used anytime, anywhere (Shurygin & Krasnova, 2016). The use of digital teaching materials in the learning process is one of the efforts to create a more meaningful and quality learning and interesting, effective, and innovative learning (Kowitlawakul, et.al, 2017).

The learning applied at this time is still not effective. This is due to various factors such as the lack of technology utilization in the learning process (Holubova, 2015). The process of the current propagation activity is still centered on the teacher-centered so that the learning activities feel saturated and dull because of the method of learning that is not varied (Schreurs & Dumbraveanu, 2014). Educators have not used any teaching materials that are interesting in school learning. Most educators still use printed teaching materials in the form of package books and worksheets (Victor, 2016). The use of teaching materials and monotonous methods makes students lazy and bored so that it affects the independence of learning (Porcaro & Carrier, 2014). Low self-reliance learning students because learners are less confident in learning (Yusuf, et.al, 2017). Learners do not dare to ask educators about ununderstood material (Red'ko, et.al, 2015).

The result of an interview with educators at SMAN 12 Padang, according to one of the physical educators of Mother Y stated that there are still a lot of learners who think that physical subjects are difficult and full of formulas. During the learning process, learners await instruction from educators to do things without their initiative. Learners are still struggling to understand the material with printed materials because they have language that is difficult to understand and less appealing to learners. There are no teaching materials in the form of E-modules used during learning. Then, the lack of learning time is in the process of causing the material is not entirely delivered by educators while the material taught is quite a lot. Besides, there are no teaching materials to support the independence of students learning such as teaching materials that can be accessed anywhere and anytime.

From the issue, educators must be able to create conducive learning conditions so that during the learning process the learners are enthusiastic in following the lesson (Aswirna, 2018). It takes a teaching material that can attract interest and independent learners so that the learning process that is teacher-centered or centered on educators can change towards student-centered or centered on learners (Ellizar, et.al, 2018). Teaching materials that educators can use to support students ' independence by using modules (Vogt, 2016).

Modules are a set of planned learning and are used to help students learn independently, and can achieve the objectives of physical learning (Ferenčíková, 2017). Modules can be interpreted as subject matter compiled and presented in writing in such a way that the readers are expected to absorb the material itself (Wang & Peng, 2014). The advantages of the module are visible from its characteristics, namely (1) Self instructional; (2) Self-contained; (3) stand-alone; (4) Adaptive; and (5) User-friendly (Satriawati, 2015). The advantages of these modules can help learners to master their competencies and achieve the expected learning objectives (Frivaldsky, et.al, 2014).

E-modules can be developed by utilizing a computer known as E-Module (Serevina, 2018). Innovation module in the form of electronic modules by utilizing media information technology needs to be developed in the 21st century (Chong, et.al, 2005). This electronic module (e-module) affects the existence of generation Z, which is the intelligent generation of technology and has a strong desire for self-directed (Kistofer, et.al, 2019). E-modules help in navigation, allowing display or loading of images, audio, video, and equipped formative tests or quizzes (Fisnani, et.al, 2020). E-Module is a set of non-printable digital teaching media that is organized systematically and used for self-learning activities, so it can demand learners to learn to solve problems in their way (Mishra, et.al, 2017).

E-modules can assist and facilitate educators in delivering material in the learning process (Sendari et al., 2019). E-modules are selected in the discharge of problems related to improving the quality of learning in the subjects of physics because it can facilitate communication between learners and educators, subject matter, and among fellow learners in terms of the situation, condition, time, or place (Darmaji et al., 2019). This is because learning with this e-module can not only be done during school hours but can also be outside school hours (Murai, et.al, 2016).

Previous research conducted by (Shurygin & Krasnova, 2016) on Electronic Learning Courses as a Means to Activate Students ' Independent Work in Studying Physics stated that E-Learning can make students learn independently in physics lessons. Research conducted by Abidin & El Walida (2017) concerning the development of Case-based interactive E-modules (Creative, Active, Systematic, Effective) as an alternative Media learning geometry of transformation to support self-reliance learning states that this E-module can support the independence of students learning. This e-module can not be on Android, so this e-module could only be used on a computer or laptop. Furthermore, the research developed by Pujiono (2017) developed the “Construct 2” based interactive learning Media on the Indonesian history subjects Hindu Buddhism has an advantage that it looks interesting and already contains materials and learners can learn with fun. The drawback has not been a researcher

developing an E-module using "Construct 2". Some research has been done before, some things have not found the author so that it is the reason writers to create the latest product.

E-Module developed in this research using "Construct 2" software applications that can be Android so that it can support the independence of learners learning because it can be accessed anywhere and anytime. The product e-module physics is equipped with exercise problems, where the training is made to merge in E-modules as well as notifications related to the achievement of students will appear when students work on the training, so students can know directly to the extent that they understand the material that has been learned and support in the independence of learning. Based on the explanation above, this research is aimed to produce a product in the form of E-module Physics using "Construct 2" to support the independence of learning students who are valid, practical, and effective.

Method

Types of research used in Research and Development (R&D). Research and Development is a method that can test the effectiveness of developed products (Sugiyono, 2010). The developed product is e-module physics using "Construct 2" to support the self-reliance of learners. The research and development used the model of the Plomp by Plomp & Nieveen (2013). This model consists of 3 stages, namely 1), preliminary research/preliminary research (this stage includes 2 main steps, namely (a) analysis of needs, (b) analysis of literature); 2) Development of prototype phase/development or prototype phase (this phase includes 3 basic steps, namely (a) designing prototypes, (b) formative evaluation, (c) revision of prototypes); 3) Assessment of phase/assessment phase. The development steps of the model Plomp can be seen in Figure 1.

The data types in this study are qualitative data and quantitative data. Qualitative Data is the result of interviews for analysis of development needs as well as suggestions from validators in developing e-modules. While quantitative data is the score data obtained from the poll to the quality of e-modules from the aspect of validity, practicality, and effectiveness. The validity tested in the development of e-modules is the validity of the material, media, and language completeness. The data in quantitative analysis is the assessment/Response poll data from product validation and test.

The instrument used in this research is a poll sheet to test the quality of e-modules of the aspect of validity, practicality, and effectiveness. All instruments before use are validated by the validator. The validator validates five people, which are two material validators, 2 media validators, and 1 person as a language validator. The material aspect is assessed by 2 lecturers who are experts in physicist material, this aspect is assessed based on the material feasibility of the E-module physics using "Construct 2". The media aspect is judged by 2 lecturers who are media experts, this aspect is assessed based on the feasibility of media from e-module physics using "Construct 2". The linguistic aspect is judged by one lecturer who is an Indonesian linguist, this aspect is assessed by language and the use of punctuation in the E-module physics using "Construct 2".

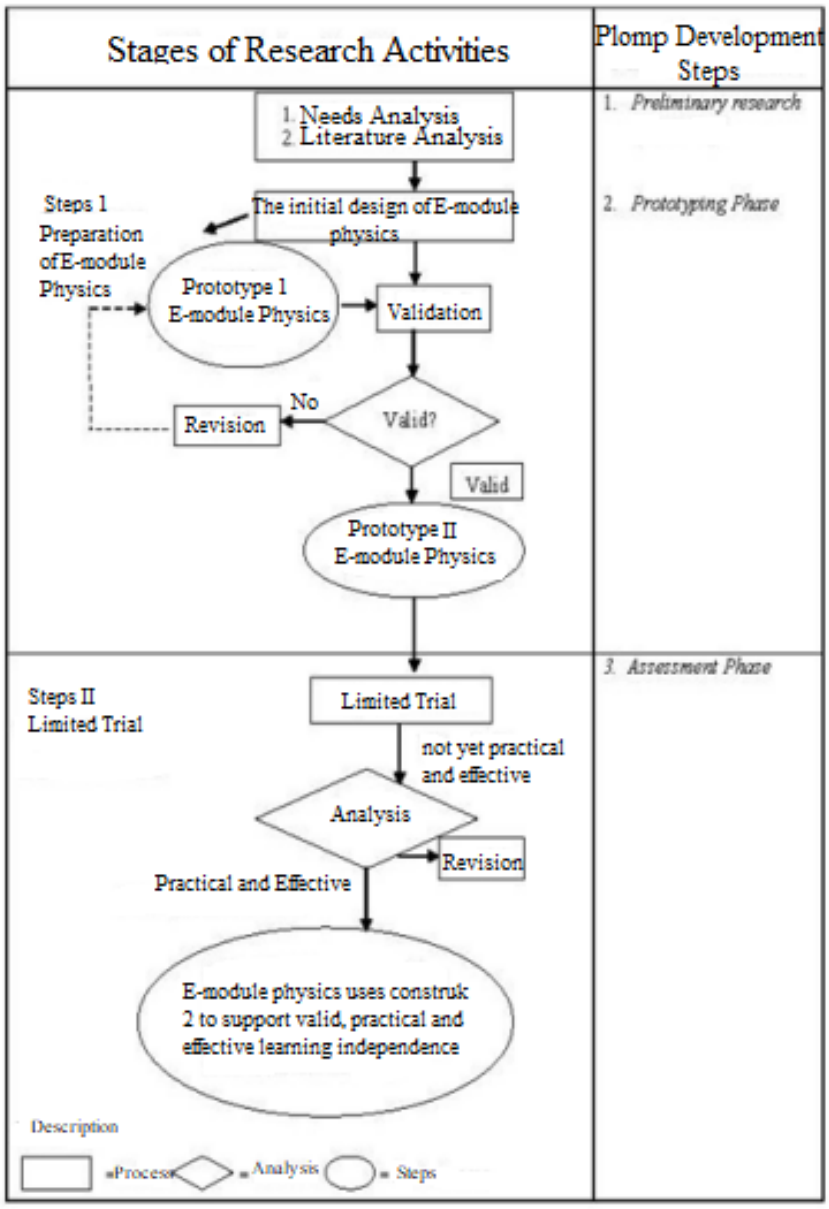

Figure 1. The Development Steps of The Model Plomp

Practical tests are seen from the ease of access to lessons learned by educators and learners. Educators and learners can access lessons from this e-module without being limited by space, time, and place and have flexibility. Practicality shows the level of achievement and practicality of the E-module physics using "Construct 2". The practical product can be seen by looking at a practical poll assessment by 2 physics educators and 15 students of class XI IPA 2 SMAN 12 Padang in using e-module physics using "Construct 2" developed. Test the effectiveness seen from the self-reliance aspects of learning learners using the E-module physics using "Construct 2" as additional teaching material for learning. This effective test is given to 20 learners in class XI IPA 2 SMAN 12 Padang.

Collected Data is analyzed using Likert scale techniques with positive categories. The validation end value is analyzed in the scale (0-100) obtained from the formula (1):

$$V = \frac{X}{Y} X 100\% \text{ ----------} \quad (1)$$

With V being score percentage earned, X is the score earned and Y is the maximum score. This final value is referenced at intervals of determination of validity, practicality, and effectiveness.

Results

Preliminary Research

In this phase, researchers analyze needs and literature studies.

Need analysis Stage

Researchers collect, analyze information, and provide problems related to the use of learning resources. The result of an interview with the educators of SMAN 12 Padang that the learning applied at this time was in the process is still not effective. The process of learning activities applied today is still centered on educators (teacher-centered) and has not used the technological developments in his studies. Educators are still using the learning resources in the form of package books and worksheets. The use of monotonous teaching materials and methods makes students lazy and bored so that it affects their learning independence. Low self-reliance learns learners because learners are less confident while learning. There are still a lot of learners who think physical subjects are difficult and full of formulas. Learners are still struggling to understand the material with printed materials because they have language that is difficult to understand and less appealing to learners. There are no teaching materials in the form of E-modules used during learning. Then, the lack of learning time is in the process of causing the material is not entirely delivered by educators while the material taught is quite a lot. In addition, there are no teaching materials to support the independence of learning students who can be accessed anywhere and anytime. To make the learning process fun and effective for learners one of the alternative solutions is to provide teaching materials that can support the achievement of the desired learning objectives. E-module physics using "Construct 2" is expected to help educators create a fun learning process for learners and can make learners active in learning.

Stage of literature analysis

1) Stages of curriculum and material analysis
   Curriculum analysis and material include the following:
   a. Core competence (Kompetensi Inti/KI)
   b. Basic competence (Kompetensi Dasar/KD)
      (1) Static fluid: Apply static fluid laws in daily life.
      (2) Dynamic fluid: Apply the principle of fluid dynamics in technology.
2) Teaching Materials analysis Stage
   The result of an interview with the educator SMAN 12 Padang that the teaching materials used in the school are still a printing material such as package books and worksheets, where sometimes the teaching materials are not suitable to the needs of students. The

printed materials used are text-only that do not contain audio and video so that many learners are lazy and bored to learn physics and impact the independence of learners. The results of the analysis that has been done, are used as a reference for designing and producing a teaching material that supports the independence of students learning. Therefore developed E-module physics using "Construct 2" to support the independence of learners' learning.

Development of Prototype Phase

This stage is a continuation of the first phase, aiming to produce a physics e-module using "Construct 2" to support the independence of a valid learner.

Designing a Prototype

At this stage, the design of e-module physics using "Construct 2" to support the independence of learners' learning. The E-modules generated with "Construct 2" is easily accessible without an Internet connection or offline, thus providing learners the convenience to use them. "Construct 2" is stored in APK format (Android Package) or Android application package model which is commonly used to store an application or program running on an Android device, so it is easily accessible by learners anytime and anywhere. "Construct 2" can be used by educators to create e-module physics as seen in Figure 2.

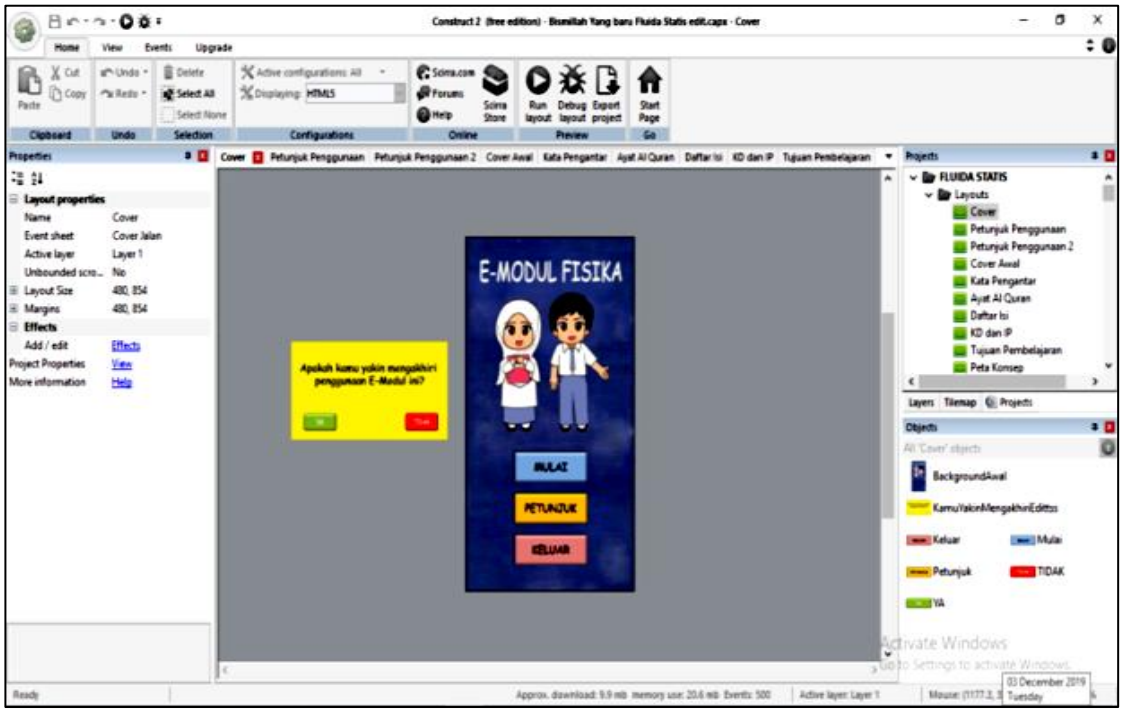

Figure 2. The E-Module Physics view using "Construct 2"

Formative Evaluation

This stage aims to generate E-module physics using "Construct 2" to support the independence of a valid learner. The physical e-module validator using "Construct 2" consists

of 5 people validators who will assess the 3 indicators contained in the E-module physics using "Construct 2" which is content feasibility, media, and language. The value of each E-module physic indicator using "Construct 2" can be determined from the average value of all statements. The three indicators of e-module physics using "Construct 2" include: 1) material worthiness, 2) media feasibility, 3) language eligibility, can be shown as follows:

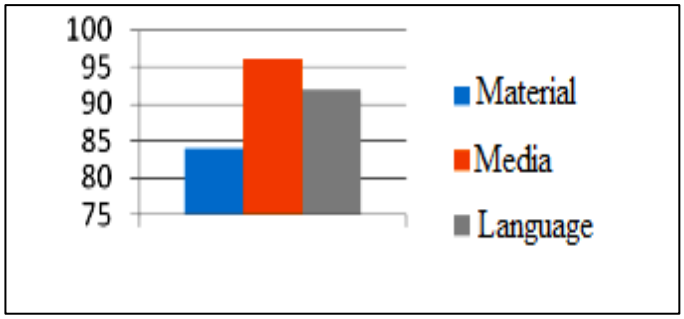

Figure 3. Histogram Test Results by Validators

The results of material validation analysis obtained the value 84, the media obtained the value 96, and the language obtained the value 92. Judging from the validation results can be suggested that the three indicators of e-module physics using "Construct 2" are in a very valid category. The result of validation analysis by the validator acquired the average validity value of e-module physics using "Construct 2" is 90.66.

Prototype Revision

Revisions to the product design are made based on input and suggestions from the validator on formative evaluation.

Assessment Phase

The purpose of this stage is to see the practicality and effectiveness of prototype II e-module physics using the "Construct 2" result development phase.

Practical Test E-module physics

The practical test is derived from the filling of the poll conducted by 2 physics educators and 15 learners. An indicator of a statement for practical testing by educators and learners of as many as 10 statements.

a) Practical tests by physics educators

The practical test of E-module physics uses "Construct 2" to 2 people of physics educators by spreading practical appraisal questionnaire. Data on the results of practicality by 2 physics educators can be seen in Table 1.

Based on the results of the educators' practitioners can be expressed that the average value of practicality by educators on e-modules physics using "Construct 2" is 97 with very practical categories.

Table 1. Average value of the practicality of a physics educator

No	Statement	Value	Description
1	E-Module Physics using Constructure 2 can save study time	100	Very Practical
2	E-Module Physics using "Construct 2" is easy to use in learning	100	Very Practical
3	E-Module Physics using "Construct 2" makes it easy to understand the concepts of Physics	90	Very Practical
4	E-Module Physics using "Construct 2" makes it easy to learn anywhere and anytime	100	Very Practical
5	E-Module Physics using "Construct 2" can help educators deliver the material	100	Very Practical
6	E-Module Physics using "Construct 2" can make it easier for educators to convey messages quickly and easily to remember	90	Very Practical
7	E-Module Physics using "Construct 2" makes it easy to understand the use of physical formulas	90	Very Practical
8	E-Module Physics using "Construct 2" can support the learning independence of students	100	Very Practical
9	The E-Module Physics using "Construct 2" can help educators provide opportunities for students to learn according to their own pace	100	Very Practical
10	E-Module Physics using "Construct 2" can attract the attention of students in learning physics	100	Very Practical
Average		**97**	**Very Practical**

b) Practical test by learners

A practical test is done by spreading the practical Assessment Questionnaire E-Module physics to learners. The results of practical data by 15 learners can be seen in Table 2 as follows:

Table 2. Average value of students ' practical results

No	Statement	Value	Description
1	E-Module Physics using "Construct 2" can save my study time	93.33	Very Practical
2	E-Module Physics using "Construct 2" is easy for me to use in learning	93.33	Very Practical
3	The E-Module Physics using "Construct 2" presents material that is easy for me to understand	94.66	Very Practical
4	E-Module Physics using "Construct 2" can make it easier for me to study anywhere and anytime	93.33	Very Practical
5	E-Module Physics using "Construct 2" I can use repeatedly	93.33	Very Practical
6	E-Module Physics using "Construct 2" makes it easy for me to work on the physics questions	86.66	Very Practical
7	The E-Module Physics using "Construct 2" makes it easy for me to understand the use of physics formulas	88	Very Practical
8	The E-Module Physics using "Construct 2" can support me to study independently	92	Very Practical
9	The E-Module Physics using "Construct 2" allowed me to learn at the speed of my ability to understand the lesson	90.66	Very Practical
10	E-Module Physics using "Construct 2" makes learning more fun	94.66	Very Practical
Average		**91.99**	Very Practical

Based on the results of the practitioner can be expressed that the average value of practicality by learners to e-module physics using "Construct 2" is 91.99 with very practical categories.

Effective Test of E- module Physics

The effectiveness of the use of e-modules physics using "Construct 2" can be seen by spreading the learning independence poll to 20 students of class XI IPA 2 SMAN 12 Padang. The effective sheet consists of 10 statements about the student's response to the E-module physics using "Construct 2" to support the independence of learners. Learners are asked to respond to self-reliance learning to the use of e-modules physics using "Construct 2" can be seen in Table 3.

Table 3. Average value-effective E-Physics modules by learners

No	Statement	Value	Description
1	I believe in self-ability when learning with the E-module Physics using "Construct 2"	90	Very Effective
2	I better understand physics if learning with E-module physics using "Construct 2"	89	Very Effective
3	I was able to work on the questions without help from others with E-Modul physics using "Construct 2"	90	Very Effective
4	I became concentrated learning with E-Modul physics using "Construct 2"	86	Very Effective
5	I utilize my free time to learn with E-Modul physics using "Construct 2"	91	Very Effective
6	I will work alone and act honestly during a physics exam with E-Modul physics using "Construct 2"	88	Very Effective
7	I keep learning when teachers are absent with the help of E-Modul physics using "Construct 2"	87	Very Effective
8	I can learn physics where and whenever with E-module physics using "Construct 2"	91	Very Effective
9	I want to have better physics value from my friends after learning with E-module physics using "Construct 2"	94	Very Effective
10	I am looking for another reference (book package or the Internet) if I have difficulty learning physics in school	86	Very Effective
	Average	**89.2**	Very Effective

Based on the results the respondent can be expressed that the average effectiveness to support the independence of students learning after the E-module Physics using "Construct 2" is 89.2 with very effective categories.

Discussion

Validity of E-module Physics

Data analysis results show the E-module physics by using "Construct 2", which was developed in a very valid category based on the validator assessment. According to Sugiyono (2010) validation can be done by some experts who are experienced to assess the advantages and disadvantages of the resulting product. According to the opinion of Wahyuni, et.al (2018) that the aspect of content eligibility includes the suitability of the material contained in e-

modules with KI, KD, and the purpose of learning and materials provided according to the ability of learners. This means that the e-modules developed already meet the KI, KD, learning indicators, and learning objectives. Judging by the validation of content eligibility by two physics lecturers of UIN Imam Bonjol Padang, the result of validity is 84. It means the value is categorized as very valid. The validity of the content is a very important part of module development. This is because the content in the module becomes a reference in learning activities for teachers and students. Invalid content can cause misconceptions. This misconception causes teachers and students to have a wrong understanding of the material. As explained by Klammer (1998) misconceptions can lead to obstruction of understanding and assimilation of knowledge gained by students so that it becomes a barrier for students in achieving the learning goals.

Based on media feasibility, there are several aspects which are the basis of assessment. Those aspects are concept, display (cover design, typeface, text, and image layout) (Serevina, 2018). According to Yazid (2016), aspects of media feasibility include ease of access, use of letters, color composition, animation, and display design. Judging by the validation of media feasibility by two physics lecturers of UIN Imam Bonjol Padang, the result of media validation is 96. So it is categorized as very valid. The attractive concept and display of a module can increase student motivation to learn. However, this is not enough for media validity in the development of this module. Module display (images, text, layout, etc.) must be clear and have the right size and comparison.

Judging by the validation of languages by a lecturer of language, the result of validity is 92. So it is categorized as very valid. This indicates that the writing and use of language in the E-module are following the rules of good and correct Indonesian grammar (Setiadi, 2016). The use of good and correct grammar is important to send the right message. Grammatical errors can lead to misconceptions and/or give ambiguous meanings. Klammer (1998) states that this misconception can hinder the achievement of learning objectives. So that the word and sentence structure must be solid and clear without causing misconceptions and ambiguity.

From the results of the three validity test indicators above, the average validity value of the E-module with a very valid category. Overall, the E-module Physics using “Construct 2” can already be used as a learning-teaching material in the physics learning process. The E-module Physics using “Construct 2” has been declared to be very valid by the experts.

Practicalities

E-Module physics using “Construct 2” to support the independence of students learning that has been declared valid by the subsequent expert conducted practical tests. All devices have been validated and commented on by experts then revised. Revision results are then tested with a practical test aimed at knowing the ease or practicality of which can facilitate learners in understanding the material and discussion of examples of easy to understand questions (Agnezi, 2019; Fikri & Madona, 2017). The input from several experts is useful for making this media more perfect with several revisions, namely improving the writing on images and titles, clarifying and completing the formula information on the media and instructions for using the media, improving the background color in the media and

consistency in writing and the words used in the media. The efficiency of media usage time is the use of e-modules more efficient with the time associated with no need for learners to record the explanation of educators because e-module physics has been equipped with a complete material description (Marzuki, et.al 2019). A practical test is done by spreading the poll to 2 teachers and 15 learners at SMAN 12 Padang. The test result of the practical e-Module physics using "Construct 2" by 2 Educators and 15 learners in SMAN 12 Padang earned results with scores of 97 and 91.99 respectively with categorized as very practical. Based on the practical results above that E-module physics using "Construct 2" is very practical to use in learning. According to Chong et al., (2005) that the E-module is also found to be suitable to serve as an alternative (practical) learning material that helps to learn. It is very efficient against time as learners can read e-modules anywhere and anytime.

Effectiveness of E-module Physics

The effectiveness of E-module physics using "Construct 2" is seen from the independence of learning students. The effective test results obtained effectiveness value for E-module Physics using "Construct 2" with criteria effective with an average value of 89.2. The category of effectiveness following the criteria (Sugiyono, 2010) in the range of 81%-100% of a product is already said to be very effective. It can be concluded that the use of E-module physics has been effectively used to support the independence of learners.

This is also confirmed by previous research Sari, et.al (2018), Based on the results of due diligence and test product effectiveness, the E-module using the problem-based learning fluid materials dynamic that is developed worthy to serve as a source of self-learning students SMA XI class and can improve the results of cognitive learning students. Research conducted by Abidin & El Walida (2017) regarding the development of Case-based interactive E-modules as alternative Media learning the geometry of transformation to support self-reliance learning states that this E-module can make students study independently.

Conclusion

The novelty of research and development carried out is by developing e-modules using "Construct 2" in physics learning, the results of the research can be concluded that the Physics E-module developed using "Construct 2" can be classified as valid, practical, and effective to support the independence of students. This is based on the validity test starting from the feasibility test of the content, media, and language used in the E-module. Practicality and effectiveness tests can be seen from the use of e-modules by teachers and the functioning of e-modules as supporting students' independence in learning. This means that the e-module is feasible and can be used as a learning resource that can be used in learning physics.

The e-module physics uses "Construct 2" to support the learning independence of students can be developed by educators in other materials so that learning physics feels more meaningful and for further researchers to further develop how to build the 2 applications used.

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