



Validity and Students' Responses to Interactive E-Modules Based on Inquiry Learning Assisted by the Virtual Laboratory on Static Electricity

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DOI:10.20527/bipf.v11i2.16027

Received: 4 April 2023 Accepted: 30 June 2023 Published: 30 September 2023

Abstract

The development of an interactive e-module based on inquiry learning assisted by a virtual laboratory on static electricity was created to produce innovative learning media and follow the trends of the 5.0 learning era. Therefore, the research was directed at validating the material and media in related modules and measuring students' responses to the modules being developed. This research used Borg and Gall's ten-step research and development model. However, the Borg and Gall development model in this study was modified into six research steps: research and information collecting, planning, developing preliminary from product, preliminary field testing, main product revision, and main field testing. The research respondents were 30 students from class XII IPA at MAN 1 Hulu Sungai Tengah. The product validity results by material experts reached V Aiken's 0.91, and media experts reached V Aiken's 0.96, both of which are in the high validity category. The results of student responses show an average value of 90%, equivalent to a very good product category. Thus, the interactive e-module based on inquiry learning assisted by the virtual laboratory on static electricity is included in the "strongly agree" category to be suitable for use.

Keywords: E-module; Inquiry Learning; Interactive; Static Electricity; Virtual Laboratory

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How to cite: Nurliani, F., Rahmawati, I., & Suryandari, S. (2023). Validity and students' responses of interactive e-modules based on inquiry learning assisted by the virtual laboratory on static electricity. *Berkala Ilmiah Pendidikan Fisika*, 11(2), 230-241.

INTRODUCTION

Physics is the science that studies physical phenomena in the universe. Over time, physics plays an important role in the development of science and technology. Development rapidly creates a more conspicuous space for teachers to

reveal their creative ability in the guidelines. Especially amid the widespread COVID-19, online learning may be a challenge in itself inside the world of instruction, both in terms of instructors and students staying up to date from the transition from conventional



learning to learning that demands ICT (Information Communication and Technology) operating skills. The key to the effectiveness of online learning comes from how teachers maintain creativity in presenting online learning. This makes the learning environment fun and understandable for students, keeps them from getting bored, and helps them stay productive while learning at home (Alqurashi, 2016; Barrot et al., 2021; Naspawati, 2020; Syauqi et al., 2020).

The main problem at school is that physics is also considered difficult for students. From the author's interview with the physics teacher at MAN 1 Hulu Sungai Tengah, students have difficulty memorizing formulas, understanding formulas, and recognizing symbols and units. Many mathematical formulas are involved in physics lessons, so students perceive physics as a lesson that contains only a set of formulas. Students insist on memorizing physics formulas instead of practicing real science skills (Erlina et al., 2018; Istiyono et al., 2019; Maknun, 2020). Besides that, abstract physics material such as static electricity also makes it difficult for students to understand the concept (Kizito et al., 2019; Yanti et al., 2019). The lack of students' abilities in science, especially physics, is basically due to the lack of student involvement in learning science (Azizah et al., 2019).

One alternative learning model that allows students to connect the acquisition of physical concepts to real phenomena through direct experimentation by students themselves is the inquiry model. In the research model, students conduct systematic research. The ability to think logically and critically requires analysis to find original answers to existing problems. The impact of test models on learning should also be able to improve learning outcomes, mastery of concepts, improve critical and creative thinking skills, and improve students' scientific attitudes (Kusdiastuti et al., 2016;

Nasution, 2018; Umami & Jatmiko, 2013). The lack of practicum activities resulted in students' lab skills tending to be low. Practicum videos and tutorials can assist teachers in guiding students to understand the subject matter (Limatahu et al., 2017; Indrawati et al., 2022; Koenig et al., 2022). In line with the statement above, using video in this inquiry model can also improve learning outcomes and increase student motivation (Suryandari et al., 2016).

Inquiry learning is inseparable from the laboratory, which is used as a place to carry out various physics experiments (Radhamani et al., 2021). Of course, an ideal laboratory must be supported with complete facilities. However, schools, in general, are still limited in practicum tools; they don't even have practicum tools at all. MAN 1 Hulu Sungai Tengah is also a school that rarely implements inquiry learning due to the lack of practicum tools (Kusdiastuti et al., 2016). The uneven distribution of physics laboratory facilities and infrastructure in every school can be overcome by using technology as another alternative. Now a virtual laboratory can be accessed by anyone (Radhamani et al., 2021) and is an important tool to undertake hands-on experiments effectively (Seifan et al., 2020).

Besides the limited physics practicum facilities, virtual labs are conducted because not all physics concepts can be explained through a real practicum. For example, in the case of static electricity, how electrons move, or the shape of the electrons themselves cannot be seen with the eye because they are microscopic. Due to one of the uniqueness of the virtual lab, according to Fegeley, this virtual lab can present things that are unimaginable in the real class (Fegely et al., 2020). The advantages of the virtual lab include: (1) presenting information from a fairly complex concept or physics process, (2) increasing student learning motivation, (3) can be used offline if it

has been downloaded, (4) encouraging students to think intuitively by formulating own hypothesis, and (5) the learning process becomes more interesting. The disadvantages of virtual labs include: (1) The success of the learning process depends on the independence of each student's learning, and (2) the virtual lab depends on the number of computing facilities available at each school. (Rizaldi & Jufri, 2020).

The media or teaching materials used in MAN 1 Hulu Sungai Tengah are still in the form of textbooks. Physics teachers are aware of the shortcomings of these teaching materials; namely, students are still less independent due to limited textbook explanations. In overcoming the problems above, there are teaching media more suitable for learning physics, namely modules. A module is a teaching material systematically structured according to a specific curriculum, packaged in the form of the smallest learning unit. It enables independent study within a specific time unit. (Purwanto et al., 2007). Based on Azizah's research, that is, the development of guided, research-based physics learning modules, apart from being proven effective (Azizah et al., 2019). For the modules to be studied independently, cost-effectively, attractively, and innovatively, researchers are interested in developing interactive e-modules. Electronic modules effectively motivate students, improve learning outcomes, and improve critical thinking (Puspitasari, 2019).

Researchers want to include video tutorials on using the virtual lab in an interactive e-module with an inquiry learning model. Researchers will also try to design interactive e-modules with self-evaluations that immediately provide feedback, as well as other audio-visuals if needed. This means that this interactive e-module perfectly fits the characteristics of modules: self-learning, independence,

independence, and adaptability. (Depdiknas, 2008).

Some researchers have developed interactive e-modules based on inquiry learning assisted by virtual laboratories, especially on static electricity material; this research presents similar research, with the difference being in the presentation of material collaborating with virtual laboratories and local wisdom (Banjar). According to similar research by Kusyanti, interactive e-modules with virtual labs are very practical and easy to implement, especially during the COVID-19 pandemic, to stimulate student interest in physics lessons at home. (Tri Kusyanti, 2021). Therefore, the research aimed to validate the material and media in related modules and measure students' responses to the interactive electronic modules based on inquiry-based learning supported in a virtual electrostatics laboratory.

METHOD

This type of research is a development study based on the Borg and Gall development model with ten steps of research and information collecting, planning, preliminary product development, preliminary field testing, main product revision, main field testing, operational product revision, operational product testing, final product revision, dissemination and implementation (Borg & Gall, 1983). Figure 1 shows the step-by-step process of Borg and Gall's development research.

This research has time and place constraints in perfecting the ten research steps according to the reference base used. This resulted in the research having to stop at the sixth step and with recommendations so that this research could be perfected at further opportunities. These steps are explained as follows.



Figure 1 The Borg and Gall development model

Research and Information Collecting

In this step, researchers conducted a literature review of previous studies. Then, a field study was also carried out using interviews with physics teachers at MAN 1 Hulu Sungai Tengah school. After finding the necessary data, all data is collected as a background reference for the problem.

Planning

In addition to knowing the problem, the researcher plans to formulate the problem and the objectives to be achieved in this research. Before developing a product, researchers create research instruments. This instrument was analyzed for its validity and reliability by two experts.

Develop a Preliminary form of the Product

This phase is to develop an interactive e-module product based on query-based learning supported by a virtual laboratory on electrostatic materials. Researchers create modules according to the characteristics that create ideal modules so that they can perform the functions and goals of creating interactive e-

modules. Researchers arrange modules based on inquiry learning steps.

Preliminary Field Testing

Products made will be submitted to the Material Expert Validator and Media Expert Validator to check validity. Two physics instructors and one physics teacher conducted an interactive Young's modulus validation test. Validity testing in this study uses Aiken's formula (Aiken, 1985). The validity level of a product can be determined using the following criteria.

Table 1 Aiken's validity criteria

Average Score Interval	Criteria
> 0.80	Very High
$0.60 \leq V < 0.80$	High
$0.40 \leq V < 0.60$	Moderate
$0 < V < 0.40$	Poor

(Febriandi, 2019)

Student responses to this research are expressed in percentage form and categorized based on Table 2.

Table 2 Student response criteria

Percentage	Criteria
81 – 100 %	Very good
61 – 80 %	Good
41 – 60 %	Adequate
21 – 40 %	Less
$< 21\%$	Very less

(Arikunto & Jabar, 2018)

Main Product Revision

At this stage, researchers redesigned the product according to the suggestions of material and media expert reviewers. Products that have been valid and have been revised are ready to be used for testing on students. Suggestions from the product validator are listed in Table 3.

Table 3 Suggestions from the product validator

No.	Name of Validator	Suggestion
1	SS	<ol style="list-style-type: none"> 1. The term "generates an electric charge" is not quite right. Because electricity is eternal, it cannot be generated. 2. The concept map is too general. It would be better if concept maps were also provided for each sub-chapter. 3. Provide a summary.
2	EW	<ol style="list-style-type: none"> 1. If you take someone else's picture/video, add references to pictures and videos. 2. But if the image/video is homemade, no referral is needed. 3. Quiz questions for research in high school should use type C3-C5 (Revised Bloom's Taxonomy).
3	TS	-

Main Field Testing

The revised product used is only to determine student responses, not the results of application in learning. From 30 students of class XII IPA MAN 1 Hulu Sungai Tengah, The research was conducted offline by taking data directly at the research site. Before data collection, the researcher demonstrated an interactive e-module based on on-demand learning supported by a virtual electrostatics lab with an LCD projector in front of the class. After that, students were given product links and then tried and responded to by filling out the questionnaire that had been distributed.

RESULT AND DISCUSSION

The product developed in this study is an interactive e-module based on inquiry-based learning supported by a virtual laboratory for electrostatic materials. The product can be accessed via the link <https://online.flipbuilder.com/itoqy/crod/> Before entering the link, wifi/cellular data must be ensured to be online to access the interactive e-module and activate all the features in it. Interactive e-module cover display are listed in Figure 2.



Figure 2 Interactive e-module cover display

Validity of Inquiry Learning-Based Interactive E-Module Assisted by Virtual Lab

Material and media experts have validated the inquiry learning-based interactive e-module assisted by a virtual lab. The validation results are shown in Figures 3 and 4.

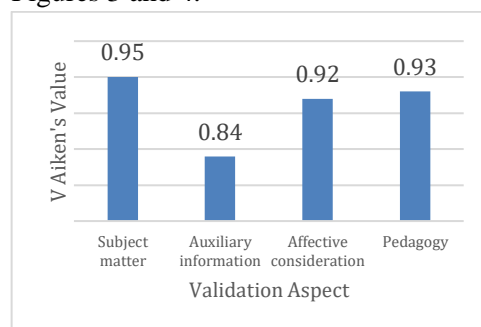


Figure 3 V Aiken's product validity from material experts

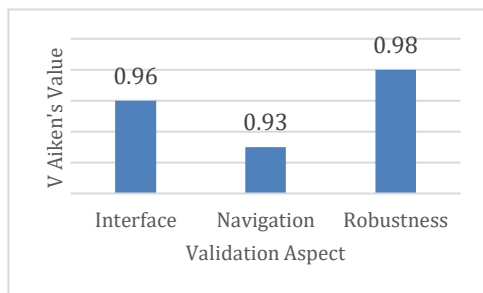


Figure 4 V Aiken's product validity from media experts

The product validity value from material experts is basically > 0.8 in each aspect (see Figure 3), so all aspects have a high validity value. Aspects of Subject Matter with V Aiken's 0.95 is the highest value, which contains the content or subject matter, meaning that the content of the product is very valid. If the subject matter is valid, learning will be more efficient and increase students' interest in learning (Rahma, 2021). Modules equipped with the material following the syllabus displayed through electronic modules function to make learning easier for students to understand and to make the learning process less interesting (Sugianto et al., 2013).

In the Auxiliary Information aspect about additional information, Aiken's V value of 0.84 occupies the lowest position of each aspect. This is because the researcher has not added any important information, namely the product summary. Then, the validator also provides suggestions for presenting concept maps at the beginning of each learning activity. In addition, researchers provide additional information that is unique to static electricity, namely a static electricity detector called an electroscope. Information about the electroscope is presented uniquely;

namely, there is an electroscope video that is arranged with automatic playback so that it looks like a moving animation. At the beginning of each learning activity, there are also critical questions accompanied by discussions that are presented briefly and as attractively as possible to broaden students' horizons. Additional information is very useful in arousing students' enthusiasm because students can learn more about existing scientific developments. So that learning does not feel monotonous and boring (Pramana & Dewi, 2014; Trnka, 2023).

The next aspect is Affective Consideration with V Aiken's 0.92 regarding how products can motivate students with interactive multimedia presentations (such as audio, video, and images) and the language used in the product. The presentation of audio, video, and images is an advantage of interactive e-modules that cannot be found in print modules (Gevi & Andromeda, 2019). The use of language in this interactive e-module also fulfills the characteristics of a good module, namely user-friendliness; user-friendly modules can be noticed using simple and generally understandable language (Depdiknas, 2008).

The pedagogy aspect of V Aiken's 0.93 contains learning strategies, quality, evaluation, interactivity, and feedback for product users. In this interactive e-module, learning strategies are designed with great regard for the characteristics of the module as stated by the Ministry of National Education: self-directed, independent, individual, and adaptable. Because a virtual lab video tutorial is provided that can be played directly without other media intermediaries, students can carry out inquiry learning

independently. Students can also listen to explanations of sample questions by clicking on the audio button so they won't get confused with symbols or units that are sometimes unfamiliar to students. Besides that, the fulfillment of pedagogy in interactive e-modules, such as quizzes and self-evaluation in interactive e-modules, also follows the purpose of making the module, namely facilitating the measurement of student learning outcomes (Depdiknas, 2008).

The product validity from media experts also received an Aiken's assessment of > 0.8 in each aspect, so each aspect had high validity. The first aspect of the interface with V Aiken's 0.96 contains multimedia displays. If the interface aspect is valid, then the type, font, layout, display between module parts, content layout, placement of illustrations, images, graphics, and the overall design of the e-module have been detected to be able to attract the user's attention (Gevi & Andromeda, 2019).

The navigation aspect with V Aiken's 0.93 contains using the Table of Contents to move between pages so that users are no longer fixated on the table of contents. Navigation on this e-module should function as expected (Rindaryati, 2021). The ease of using the module depends on how good the module's operation is through page navigation (Nisrina et al., 2022; Rahmawati et al., 2021; Sugianto et al., 2013).

The robustness aspect with Aiken's V 0.98, which occupies the position of the highest validity in each aspect, contains the stability of the product when used and how high the product's durability is in minimizing errors. The good resilience of e-modules depends on the resilience of the media to possible errors, the smooth

functioning, and the usability of the buttons so that they run properly (Gevi & Andromeda, 2019).

Student Response to Inquiry Learning-Based Interactive E-Module Assisted by Virtual Lab

The percentage of student responses to interactive inquiry-based e-modules assisted by virtual labs on static electricity can be seen in Figure 5.

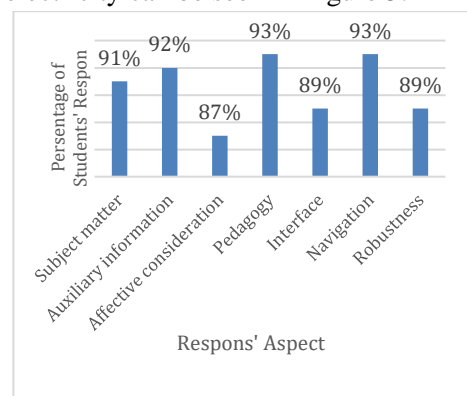


Figure 5 Percentage of student responses to the product

Student response to the first aspect, namely Subject Matter, reached 91% regarding the presentation of the material. The material in this interactive e-module is presented systematically to help students understand static electricity material. The interactive e-module contains an introductory video on static electricity, which aims to arouse students' interest, pictures supporting material that follows the content of static electricity material to make it easier for students to describe the shapes or components that exist in static electricity, pictures of figures who invented static electricity so students can find out visuals of static electricity scientist figures, even pictures of everyday life phenomena related to static electricity are presented with the aim that students can better recognize the

description and usefulness of the application of static electricity around them. The virtual lab in this interactive e-module can support students' understanding because it aims to attract and facilitate users in learning the material. Presentation of inquiry learning syntax, such as presenting critical questions at the beginning of each learning activity, directs students in achieving competence (Gevi & Andromeda, 2019).

In the Auxiliary Information, the aspect reaches 92%. It is about additional information. In this interactive e-module, students are very enthusiastic when additional information about the electroscope is presented with the help of an automatic video. Additional information as extra support from the material will enrich students' knowledge in the learning process (Riyah & Fakhriyana, 2021).

The Affective Consideration aspect accounts for 87% of how the product can motivate users. For students to be more motivated in carrying out virtual labs, practical instructions are needed that are simple and easy for students to understand (Lesmono & Wahyuni, 2021). Inquiry learning displayed through video can stimulate student interest because student interest in the video then arouses curiosity in students (Suryandari et al., 2016). Therefore, in this interactive e-module, a practicum tutorial video is presented that is easy for users to understand so that anyone who sees the video can follow the virtual lab practicum.

Aspects of pedagogy gain 93%. This aspect concerns learning strategy, evaluation, interactivity, quality, and feedback. In the Pedagogy aspect, the

percentage score is the highest. From the students' comments, they were very interested in this product because it is interactive and makes it easier for them to learn independently; moreover, the instructor can immediately get the evaluation results by simply sending them assignments on the link provided in the interactive e-module. According to Astalini, feedback on interactive evaluation of learning outcomes benefits students; teachers are also helped by the ease of analyzing student learning outcomes in their class, so interactive e-modules are very relevant for monitoring student learning progress (Astalini et al., 2019). Blaschke researched the inclusion of technology in student learning, which can train students to learn independently (Blaschke, 2021). According to Pentury et al. (2021), by using educative digital media, learning strategies like this are effectively used in learning and trigger students to be active in the learning activities. In addition, according to Sahronih, interactive learning media can stimulate students' cognitive levels, which can be seen in increased learning outcomes. Through interactive learning media, students get encouragement to be more motivated with learning strategies that involve the creativity of teaching technology (Sahronih et al., 2020).

The interface aspect gains 89%. This aspect is related to multimedia display. A small number of students feel that interactive e-modules lack bright nuances with bright color perceptions that can increase enthusiasm for learning. The determination of e-module design should be made as attractive as possible to facilitate and attract user interest (Pramana et al., 2020). Covers that describe the material can help students

more easily understand the material. In addition to the cover being able to attract student's attention, the appearance of the cover can also improve student learning outcomes (Muller & Wulf, 2020).

The navigation aspect reaches 93% regarding the ease of moving pages; students are reliable in operating page moving features such as the Table of Contents because, indeed, through the Table of Contents, searching pages is much faster than looking at the table of contents, this is where the interactive e-module excels. The Robustness aspect gets 89%. This aspect is about product durability and minimizing errors. When the research was conducted, there was indeed a technical error at that time; one of the links in the interactive e-module was not detected by internet searches. But the results usually function again when the link is written manually in the search. The high percentage of navigation and robustness shows that interactive e-modules can be used easily and smoothly (Rahmawati et al., 2021). The average result of all aspects reaches 90%, which means that this product is considered "very good" by the respondents.

CONCLUSION

An interactive e-module based on inquiry learning assisted by the virtual laboratory on static electricity was declared valid with high validity criteria by material experts with V Aiken's 0.91 and media experts with V Aiken's 0.96. Student responses to the product from the seven aspects of the assessment reached 90%, meaning the product was rated very well by the respondents. The results of this research product development have been assessed as valid and in the good

category by the respondents. Further research is needed to test the product's effectiveness on students' learning abilities.

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