The Validity of Electronic Practicum Module Based on Scientific Argumentation for Practicum Media During COVID-19 Pandemic

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Abstract. The process of learning to teach face-to-face was transformed into online learning and self-assignment during the Covid-19 pandemic. Not all learning materials can be resolved by online assignments or lectures, especially learning involving scientific processes and practicum activities. Also, the analysis of various student practicum reports shows the lack of students' ability to analyze data based on the appropriate theory. Therefore, this research aims to develop an electronic practicum module based on scientific argumentation that can be used by students as a practicum media in the Covid-19 pandemic. The type of research used is development research with ADDIE (Analyze, Design, Develop, Implement, and Evaluate) models. The developed electronic practicum module has been validated with expert judgment by five experts through validation questionnaires. Validation poll results are then changed with a five-scale score conversion based on the ideal standard deviation to determine the product validation criteria. The calculation results show that the product is in an outstanding category and ready to be tested. Furthermore, trial activities will be conducted to determine the practicality and effectiveness of product intervention on the students' scientific arguments ability.

1. Introduction

Science is a field that studies various objects in nature to produce products that can make life easier. Scientific activities are inseparable from work in the laboratory [1]. In the context of physics learning, experiments in the laboratory are necessary for students to prove the theory studied in the classroom to be meaningful [2]. The activity will allow students to be skilled in using laboratory equipment while instilling scientific attitudes. Therefore, laboratory experiments are an essential learning process for science-based programs to shape and embed scientific concepts, theories, and students' attitudes.

The Physics Education Study Program of Palangka Raya University have practicum programs as part of its curriculum. However, the COVID-19 pandemic made the experiment unable to be appropriately organized. The learning process is also changed to be entirely online, where lecturers and students interact through video conferences, learning management systems, or social media applications. Nevertheless, the psychomotor skills and science process skills such as hypotheses, retrieving and processing data, analyzing, and making conclusions will be difficult to achieve simply
by assigning tasks. If this condition continues, then the competency of graduates in physics education study program will be reduced.

The practicum constraints not only occur during pandemics but in regular times, also has many obstacles. Many students do not prepare well before practicum. The practicum guidance module, which is a mandatory item, is not carried. When the practicum began, many students lacked understanding of working procedures and how to use measuring instruments, so relied heavily on assistants. They do not recognize the material tools that will be used; this indeed inhibits the process of retrieving data. This problem arises because it turns out that students are lazy to read print modules that have been shared. In the end, the students too relied on assistants during the experiment, so the expected psychomotor skills were not achieved.

The essence module is a teaching material that students can use independently. Modules are organized to clarify and make it easier to present the material without being too verbal [3]. However, if students are not motivated to use it, then the learning process is certainly disrupted. So, this study intends to develop a new practicum module. The modules developed are expected to make it easier for students to understand the practical process, can be carried anywhere, increase students’ motivation using modules while facilitating practical activities during the Covid-19 pandemic. One module format suitable for such characteristics is an electronic module (e-module).

Electronic modules can be operated through electronic devices like smartphones, tablets, and laptops [4]. Commonly used formats for e-modules include PDF, epub, and web HTML, with their respective advantages and disadvantages. Some research on e-modules has been done before. Asmiyunda, Guspatni, & Azra [5] used web-based e-modules for chemical practicum. Students were invited to conduct simple chemical experiments with the module that can be done on their own. The web-based module was also developed by Dhina, Hadisoebroto, & Mubaroq [6] to study pharmaceutical physics. Web-based e-modules have flexibility because they can be accessed from a variety of places and devices. However, the version module has a drawback because if the student does not have an internet network, then the module cannot be used.

Another frequently used e-module format is an electronic publication (epub). Astalini, Darmaji, Kurniawan, Anwar, & Kurniawan [7] create e modules based on problem-solving for fundamental physics practicum. The module is epub formatted, with image illustrations to improve students' science process skills. Rustaman, Iqbal, & Amelia [8] developed epub-formatted e-modules for computer graphics courses. Rustaman et al. provide graphic design video tutorials inside the e-module. Hopefully, students can more easily follow instructions related to digital imaging technical hammering visual observation. Furthermore, Limatatu, Rahman, Abu, & Cipta [9] also included practicum videos on electronic modules for stoichiometric material. In the module, students were asked to answer the questions available after previously watching the video. Video embedding is an important feature that can be utilized creatively.

In this study, e-modules were developed in epub format because they have video embedding features and can be accessed without using the internet. The e-module allows it to be carried in a smartphone and minimizes the possibility of modules left at home, and allows the insertion of explanations in the form of videos. The video will be self-produced to explain the practical steps, the operation of practicum tools, data retrieval, and displaying it. The video can make it easier for students to understand the practicum done while obtaining measurement data. Students can use data in practicum videos during pandemics to create advanced analysis and practicum reports to intensify cognitive achievement from scientific process skills.

The practical problems in Physics Education are not only that, but there are others. The results of the students' practicum report showed the weakness of students in analyzing the data. The practicum analysis reported by many students only discusses working procedures and the activities they did during practicum. They have not been able to make statements from experimental data and associate them with appropriate theories. Specifically, students have flaws in scientific argumentation. In contrast, students need to understand how scientists communicate to spread knowledge through statements and evidence-based on theory.
Scientific argumentation can associate statements with data by considering or evaluating edified knowledge with theoretical or empirical evidence [10]. Arguments can be developed by helping students understand the relationship between data and theory. The electronic modules developed will be added scaffolding to guide arguing based on the data obtained. Budaeng, Ayu, & Pratiwi [11] states that scaffolding is an aid to students structured at the beginning of learning and then gradually eliminated in order for students to be independent. Scaffolding will be given to the initial practicum material and will be gradually reduced when entering the next material so that the practice does not rely on it in making arguments.

This research aims to develop electronic practicum modules based on scientific argumentation. Electronic practicum modules have been widely developed before, but no one has used video features as a source of data retrieval in practicum. These characteristics can be used as an independent practical medium in the COVID-19 pandemic. The electronic practicum modules developed will also contain scaffolding to develop scientific argumentation skills, none of which previously focused on those capabilities. This article will discuss the expert validation for the module.

2. Method

This research is part of developmental research with the ADDIE model. The ADDIE model consists of five stages: Analyze, Design, Development, Implementation, and Evaluation [12]. The analysis stage was held to understand the problem and get the whole picture of the solution. Once the problem and the idea of solving it are theoretically discovered, the problem-solving product was then designed at the design stage. After that, the product developed in the developing stage to be better. The development process is carried out by evaluating the product based on experts’ and users’ assessment and advice. The product is then applied on a broader scale at the implementation stage to know its effectiveness. The results are then evaluated to determine the level of product achievement. This article focuses on the development section on video validation and e-modules performed by experts.

Expert judgment was performed on the prototypes of the practicum video and electronic module [13]. Validation was provided by five validators using expert validation instruments. The instrument uses a Likert scale, and the indicators can be seen in Tables 1 and 2.

| Table 1. Indicators of E-Module Validation Instrument |
|---|---|---|
| No | Aspects | Indicators |
| 1 | Construction | The smoothness operation of e-modules on android smartphones |
| 2 | | The completeness of e-module components (cover, table of contents, user manual, practicum topics) |
| 3 | | The clarity of the manual for using the e-module |
| 4 | | The completeness of practicum topic components (title, objectives, tools & materials, experimental steps, analysis guide) |
| 5 | | The order of topic contents (title, objectives, tools & materials, experimental steps, analysis guide) |
| 6 | | The clarity of practicum objectives |
| 7 | | The clarity of tools and materials’ image |
| 8 | | The clarity of observational data tables |
| 9 | | The clarity of analysis guide |
| 10 | Content | The correctness of the physics concepts in module with physics expert |
| 11 | | The compatibility of the tools & materials image with the name label |
| 12 | | The effectiveness of the steps to achieve experiment objectives |
| 13 | | The compatibility of the observation table design with the data from the video |
| 14 | | Suitability of the analysis guide with the data in the observation table |
| 15 | | The effectiveness of the analysis guide in aiming student arguments |
| 16 | Language | The correctness of text in the module with an Indonesian spelling system |
| 17 | | Clarity of information from the sentences used |
Table 2. Indicators of Videos Validation Instrument

| No | Aspects          | Indicators                                                                 |
|----|------------------|---------------------------------------------------------------------------|
| 1  | Construction     | The smoothness of video playback                                          |
| 2  |                  | The clarity of video display                                              |
| 3  |                  | The readability of practicum data                                         |
| 4  |                  | The clarity of tools and materials used                                   |
| 5  |                  | The clarity of the text stated                                            |
| 6  |                  | The clarity of the audio                                                  |
| 7  | Content          | The compatibility of the experimental steps in the video with the scientific work concept according to experts |
| 8  |                  | The compatibility of the experimental steps in the video with experiment objectives |
| 9  |                  | The order of the experimental video                                       |
| 10 |                  | Ease of understanding experiment step video                              |
| 11 |                  | The correctness of the data in the experiment step video                  |
| 12 |                  | The compatibility of video data with experiment objectives               |

The poll score obtained by the validator was then converted into criteria with a five-scale score conversion based on the ideal standard deviation, according to Widoyoko [14]. Since this study uses five validators, the assessment criteria formed are shown in Table 3.

Table 3. Five-Scale Scoring Criteria

| Interval Score | Criteria  |
|----------------|-----------|
| X > 4.2        | Outstanding |
| 3.4 < X ≤ 4.2  | Good      |
| 2.6 < X ≤ 3.4  | Adequate  |
| 1.8 < X ≤ 2.6  | Bad       |
| 1.8 > X        | Poor      |

3. Results and Discussion

3.1. Results
Expert validation results on electronic module and practicum videos can be seen in Figure 1. For the e-module, all valuation items are of outstanding criteria, except for items 3, 7, and 19. Item 3 relates to the e-module guidance, item 7 relates to images of tool and materials, and item 19 relates to typing in the module. Validators recommend that the module’s guidance be more detailed, especially when it comes to analysis guides. Then, the validators also asked to use more exact images of tools and materials. Besides, there are some typing errors in the module that need to be fixed.
Figure 1. Graph of E-Module And Videos Validity Score

For the experimental videos, all indicators' category is outstanding, except for items 3 and 6. Item 3 relates to the readability of practicum data in the video. Some scales are hard to read in the video, such as the scale of the Ohaus balance. Then, retrieval of data in the slope also requires a signal in pressing the stopwatch. This data reading indicator is vital to improving. To that end, the scale on the Ohaus balance will be illustrated by the scale model, then the movement of the trolley in the slope will be given a countdown to make it easier to use the stopwatch. Furthermore, item 6 relates to the practicum video's audio clarity, where there is some disturbing noise in the video. This issue is resolved by using adobe audition to clear the video sound.

3.2. Discussion

Electronic module based on scientific argumentation were developed using different types of software. Microsoft word and publisher are used as programs to design module formats. For video editing, the programs used are adobe premiere pro and adobe illustrator. Modules and videos are then combined through sigil applications to produce epub-formatted electronic modules. The Reasily reader app is required to install into an android smartphone to read the e-module. The readable e-module view can be seen in Figure 2. Figure 2 shows that the e-module contains usage guidance for students to make it easier for them to understand how to use it. The e-module also comes with a practicum report format used to create final reports and temporary reports. Both features support the characteristic e-module as a standalone learning media.

Figure 2. E-module Cover, Usage Guidance, and Report Format

The examples of display of the e-module can be seen in Figure 3. There are four practical topics developed in this module: the density of solid substances, the Ohm's law, the forces on the slope, and the Melde's law. Each of these topics contains experimental objectives, the images of tools and materials, a theoretical basis, videos of practical steps, observation tables, and analysis guides. Each
topic has different usage guidance because it has a different method of retrieving data. In Figure 3, the tools and materials are displayed in the form of images to make it easier for students to recognize them when in the laboratory. Videos for different practicum activities on the same topic are separated to make it easier to use. Thus, this e-module can still be utilized as a regular practicum module when the pandemic ends.

Figure 3. Practicum Topic of Solid Substances, Tools, Materials, and Experimental Steps

The video displays the practicum steps and tool usage tutorials and displays the measurement results data. The sample data is shown in Figure 4. The video in the figure explains how the Ohaus balance is used to measure an aluminum cube’s mass. It starts from calibrating to how to shift the load arm. The measurement results can also be seen in the video. Then, the video switches to how to use the calipers to measure the length of the cube. The length measurement can also be seen in the video.

Figure 4. The Practicum Video Containing Measurement Data

Data obtained from the video can fill out observation tables and perform calculations as material to create practicum reports. In the final report, students will be assisted with guidance to make the
analysis result more appropriate as scientific writing. As seen in Figure 5, 12 questions and commands guide student analysis on the density of solid substances. Students were asked to compare the density of objects of the same size but different types, or objects of different sizes but the same type, and then asked the cause of their observed phenomenon.

**Figure 5. Analysis Guide of Solid Density**

These questions or commandments are structured to lead students to understand the concept of density. The other practicum topics also have the same features: videos containing data and analysis guides. The analysis guidance is designed to allow students to produce argument patterns, as in Figure 6. The diagram in Figure 6 shows the three components that scientific arguments have: statement, evidence, and theory. The statement is an opinion on a scientific phenomenon. This opinion should then be supported by evidence and theory [15]. Evidence is exposure to data and facts obtained from experiments, while the theory is exposure to scientific theory. A scientific theory can be proven through experiments in the laboratory, and the results of experiments in the laboratory should be following scientific theory. According to Tsai [16], this method can help students analyze experimental data and precise theories. This electronic module needs to be applied on a broader scale to know its effectiveness and practicality in the future.

**Figure 6. Scientific Argumentation Components**

Integrating video into documents is a vital feature of EPUB. Darma [17] utilizes this feature to display animation and video analysis related to physics to help students understand abstract concepts. Yuniarto [18] uses EPUB features to explain material in sports. The students can see the necessary technical demonstrations and futsal games’ rules on the video better in their research. The video makes the self-instructional module’s characteristics more robust, where students can study independently at home without the need for the presence of teachers or lecturers [19]. Even so, this e-module has flaws in terms of process. In essence, a practicum is an activity to learn science in terms of products and processes. Practicum activities make students experience themselves, follow processes, observe objects, analyze, prove, and draw conclusions about them [20] [21]. In this e-module, students cannot experience the practicum process themselves because they are only watching via video. The process
they experience is directly on observing objects, analyzing, and then drawing conclusions. However, it is better than not doing learning activities at all.

To complete the practicum report, the students need to understand how scientists build theoretical frameworks in making scientific arguments, engaging premise sets, collecting and testing data, and using empirical research results and logical reasoning as advocates to support or reject the theory [22]. The same opinion was expressed by Manz [23], which states that scientific learning activities can develop scientific argumentation. Arguments in science have three objectives: define the phenomenon studied, convey understanding, and persuade others to approve of their ideas [24]. Therefore, practices should have been argued scientifically in compiling practicum reports based on the experiments’ data and the theories surrounding them. Ultimately, a learning process that involves assessing data, evaluating, and making statements on what is observed will improve a person’s critical thinking abilities [25].

4. Conclusion
Expert judgment on prototype electronic practicum module and videos shows the validity with outstanding criteria. The module and videos of the experiment are considered valid in terms of construction and content. The electronic practicum module based on scientific argumentation has characteristics that can be operated through smartphones, has practical steps video tutorials and tool operations, has videos that display experimental data, and contains guidance for students to analyze data and associate it with theory. In the future, the module needs to be applied on a broader scale to know the practicality of the product's use and its effectiveness in facilitating scientific argumentation.

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