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Validity of Electronic Module Based on Process Oriented Guided Inquiry Learning Model to Train Students' Science Process Skills

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ABSTRACT

The research aimed to validate the electronic module (e-module) based on the process oriented guided inquiry learning (POGIL) model on the topic of Vibrations, Waves, and Sounds in junior high school. The e-module developed was expected to help students learn independently and practice the science process skills. The research method was a research and development in accordance with the Plomp (2013) model. There were three validation components in the developed e-module\, i.e.: material, pedagogical, and media validation. This e-module has been validated based on the average assessment score given by the validators. The validation results of the material, pedagogical, and media were in a very valid category, with a percentage of 91.6%, 88.9%, and 89.8%, respectively. In short, the developed e-module produced excellent assessment results. Moreover, it was feasible for use in the science learning process of junior high school and can train students' science process skills.

INTRODUCTION

The changing times in the 21st century, which are increasingly dynamic, give birth to new changes in the dynamics of education, namely the birth of the 2013 Curriculum, which emphasizes the integration of all aspects of assessments. As a result, learning in schools is expected to be able to develop the potential for attitudes, knowledge, and skills as a whole (Dewantara et al., 2019; Misbah et al., 2018; Putri & Djamas, 2017; Suyidno et al., 2017). Also, the 2013 Curriculum requires using communication technology in the learning process (Syafitri et al., 2019).

Based on the Trends in International Mathematics and Science Study (TIMSS) research, Indonesia is ranked 45th out of 48 countries in terms of scientific ability and only scored 397 points out of an average world score of 500 (TIMSS, 2015). Another study conducted by the Program for International Student Assessment (PISA) in 2018 placed Indonesia in the 73rd position out of 78 countries and only scored 396 out of an average world score of 489 (OECD, 2019). The results of the research published by TIMMS and PISA adequately reflect the condition of the education system in Indonesia, which is still far from expectations, especially in the aspect of science learning.

Hence, several things must be the focus of the teacher's attention to make an assessment of processability in the field of science, one of which is training science process skills (SPS) (Zainudin & Salam, 2021). SPS are intellectual skills that scientists have and use in doing research concerning natural phenomena (Lepiyanto, 2017). SPS form active and responsible students, realize meaningful learning, and lead students to learn research methods (Bolat et al., 2013). So, SPS need to be trained for students to master the skills to carry out various observation or experimental activities to develop science concepts (Nur & Trimulyono, 2022).

Based on interviews with science teachers at SMP N 1 Sewon, the current focus of learning science is building concepts through lectures.

Experimental activities are rarely carried out due to time constraints. As a result, students' SPS are not optimal (Setianingsih et al., 2018). Furthermore, Sumiati et al. (2018) found that some teachers have not reviewed aspects of SPS in teaching and learning activities, so students' science process skills are not measurable.

The problem with students' SPS is that, the teaching materials used by teachers are only obtained from textbooks available at schools. The science books in the 2013 Curriculum have already seen the integration of science content. However, the student activities in the book are still general, not yet lead to specific process skills activities (Rahmanto et al., 2015). SPS include observation, classification, measurement, discovery, observation, communication, defining variables, and research skills through the five stages of process oriented guided inquiry learning (POGIL), which include orientation, concept discovery, application, and closing. POGIL plays a role in activating students' SPS because it allows students to explore the characteristics and models of a concept through activities and investigations in collaborative learning (Sona, 2016). One of the junior high school science materials, i.e.: Vibration, Waves, and Sound is very feasible to be used in a guided inquiry model with a scientific approach to train SPS and guide students to conduct experiments to find the concepts of Vibration, Waves, and Sound (Puspitasari et al., 2017). Based on these problems, an effort is needed to train SPS through appropriate models and strategies. Models and strategies in learning can be designed to be integrated through teaching material (Zainudin & Salam, 2021). POGIL learning model is a model that may be used to encourage students in learning activities (Ariyati et al., 2021).

Innovation in science learning is needed to support students' independent learning in the digital era, one of which is developing teaching materials in the form of e-modules (Suastrawan et al., 2021). The rapid development of technology makes e-modules urgently need to be developed for learning (Putra et al., 2021). Laili et al. (2019) stated that e-modules can be used to complement textbooks used in learning, assist in explaining the subject matter, train students to learn independently, measure students' level of understanding, and reduce paper-use. Effective and innovative learning can be created in one way, such as using teaching materials with a learning model that attracts students' interest in learning to train students' SPS.

POGIL is a collaborative learning technique using guided inquiry in which there is an interconnected system, namely exploration, concept discovery, and application (De Gale & Boisselle, 2015). The POGIL model requires students to use metacognition, aiming they realize that they must be responsible for their learning, and need to reflect on what they have learned and what they have not understood (Yuliastini et al., 2018). In the POGIL class, students are guided to utilize basic knowledge by building their understanding of concepts so that it can become meaningful learning (Andriani, 2019).

The results of previous studies show that the comparison of student performance during POGIL is better than the conventional model (Villagonzalo, 2014). The POGIL learning model effectively improves students' SPS (Idrus et al., 2021). The POGIL model also has a positive effect on SPS and students' cognitive abilities (Misbah et al., 2015; Zamista & Kaniawati, 2015).

Validation of teaching material is very important before the teaching material is given to students as the target users of the e-module. Based on the description, a teaching material needs to be developed based on a valid learning model that students can use to understand the subject matter and get involved actively in the learning process. So, we need teaching materials in the form of well-validated e-modules based on the POGIL model to train students' SPS.

RESEARCH METHOD

This development research was designed using the Plomp development model (2013). This model consisted of three development phases, the preliminary research phase, the development or prototyping phase, and the assessment phase. Rochmad (2012) stated that the Plomp model was seen as more flexible than the 4-D model because it contains development activities at each step that can be adapted to the characteristics of the research. In this study, the development procedure was simplified into a development stage by conducting expert validity tests because the research objectives had been achieved at this stage. Thus, the e-module development procedure included preliminary research and development or prototype phases. This is explained as follows.

a. Preliminary research phase

The research phase of the development of the e-module based on the POGIL model began with the preliminary phase. The steps include front-end analysis, students' character, materials, and competencies.

b. Development or prototype phase

This phase aimed to design solutions to problems found in the preliminary research phase. In this phase, plans were designed to be applied to the product development. Harjanta and Herlambang (2018) stated the design stage as a process carried out before product development. The product designed required feedback or comments through the expert validation stage as a conceptual refinement (Rusdi, 2018). This stage aimed to determine the feasibility of the developed product. Here, product validation invited three expert validators. They are material, pedagogical, and media experts. Furthermore, the results were obtained as suggestions and comments that can be used as a basis for revising the product.

The validity of the e-module was determined using a test instrument in the form of an expert validation sheet. The expert validation assessment instrument consists of material, pedagogical, and media aspects. Validity analysis was carried out based on the questionnaire given to the validator. The data obtained from the assessment of the validation sheet was in the form of a Likert scale. The validity category of the developed e-module is presented in Table 1.

Table 1. Criteria for the validity of the validator assessment questionnaire data (Arikunto, 2021).

Percentage (%)	Criteria
81 - 100	Very worthy/very valid/no revision needed
61 - 80	Worthy/valid/no revision needed
41 - 60	Inappropriate/invalid/need revision
21 - 40	Not worthy/invalid/need revision
< 20	Very inappropriate/very invalid/needs revision

After producing the e-module, material, pedagogical, and media experts carried out validation data analysis. Cahyono (2017) stated that the data were analyzed to determine whether the learning media met the eligibility requirements. If these conditions are met, then a quality product is obtained. The data from the experts were averaged and then categorized into interval ranges, as presented in Table 1.

RESULTS AND DISCUSSION

The product developed in this research is an e-module based on the POGIL model to train students' SPS. This research is limited to the preliminary and development or prototype phases. We analyze previous studies, students' character, materials, and competencies in the development process. The development of this e-module aims to support science learning activities in junior high schools and train students' SPS. This e-module contains the introduction, content, and closing sections, adapted from the Ministry of National Education (2008). The display of the POGIL model-based e-module cover is presented in Figure 1.

The e-module cover is made as attractive as possible to attract students' attention to study with the e-module based on the POGIL model. Hence, one expected output of this e-module is that students become more interested and enthusiastic in the learning process.

The design stage or prototype design stage, according to Ayuntini et al. (2018) consists of the selection of the format and initial product design. This stage aims to design a product as a science e-module based on the POGIL model to train students' SPS.

Three learning activities are included in the e-module. First learning activity is the concept of vibration. The second learning activity is the concept of waves. Finally, the third learning activity is the concept of sound.

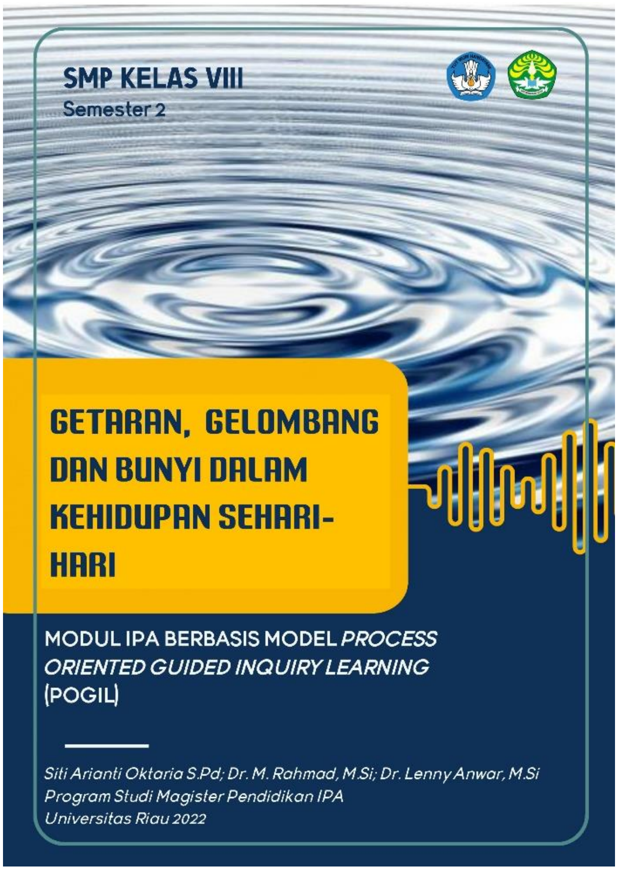
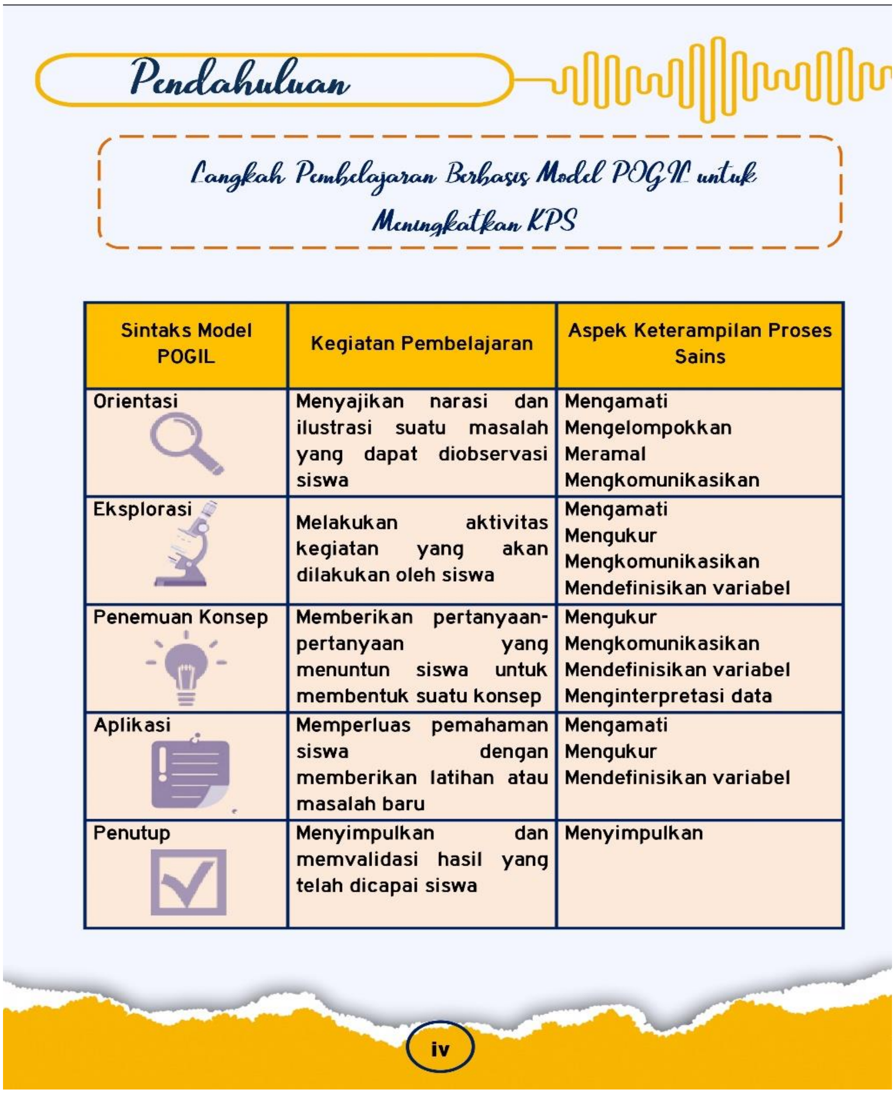


Figure 1. E-module cover display

In the Introduction part of the e-module, there are explanations of the learning syntax of the POGIL model, description of the e-module, instruction for use, basic competencies, and a concept map. Furthermore, the content section contains learning activities with the POGIL model syntax, which consists of orientation, exploration, concept discovery, application, and closing. The display of the syntax description of the POGIL model for the developed SPS indicators is presented in Figure 2.


Pendahuluan

Langkah Pembelajaran Berbasis Model POGIL untuk Meningkatkan KPS

Sintaks Model POGIL	Kegiatan Pembelajaran	Aspek Keterampilan Proses Sains
Orientasi	Menyajikan narasi dan ilustrasi suatu masalah yang dapat diobservasi siswa	Mengamati Mengelompokkan Meramal Mengkomunikasikan
Eksplorasi	Melakukan aktivitas kegiatan yang akan dilakukan oleh siswa	Mengamati Mengukur Mengkomunikasikan Mendefinisikan variabel
Penemuan Konsep	Memberikan pertanyaan-pertanyaan yang menuntun siswa untuk membentuk suatu konsep	Mengukur Mengkomunikasikan Mendefinisikan variabel Menginterpretasi data
Aplikasi	Memperluas pemahaman siswa dengan memberikan latihan atau masalah baru	Mengamati Mengukur Mendefinisikan variabel
Penutup	Menyimpulkan dan memvalidasi hasil yang telah dicapai siswa	Menyimpulkan

iv

Figure 2. Display of the Introduction to the POGIL model syntax.

Every learning activity in the e-module includes indicators of SPS proposed by Rezba et al. (2007). Furthermore, the contents of the e-module are accompanied by material notes, evaluation in the form of questions that can train students' SPS, and follow-up to the evaluation. The display of the contents of the e-module is presented in Figure 3.

Figure 3. E-module content display.

Materials, pedagogy, and media experts have validated this e-module. The expert who validated this product was a postgraduate lecturer at the Faculty of Teacher Training and Education at the University of Riau. Sukardi (2011) suggests that validity is an assessment of a product. The results of the validated e-module based on the POGIL model is presented in Table 2.

Table 2. E-module Validation Results

Expert Validation	Assessment Aspect	Mean	Maximum Score	Result Average (%)	Category
Materials	Content Eligibility	29	48	91.6	Very valid
	Questions	15			
Pedagogy	Learning Design	33	68	88.9	Very valid
	SPS Implementation	27.5			
Media	Cover Design	15	64	89.8	Very valid
	Content Design	28			
	Language	14.4			

In planning the use of the science e-module, it must pass validation test which assessed by the experts. Validators are allowed to assess so that the e-module is feasible for use in learning (Imansari & Suryantiningsih, 2017; Irwansyah et al, 2017; Fonda & Sumargiyani, 2018).

Table 2 shows the product quality criteria for each aspect of feasibility. First, the material aspect of the e-module is categorized as "very valid." The material validator states that the aspects of the feasibility of the content and questions presented in the e-module are appropriate competence. In terms of the truth, almost all concepts are following the definitions that apply in the field of science, do not cause multiple interpretations, based on phenomena of everyday life, and do not cause misconceptions. In addition, the sample and practice questions in the e-module have covered all sub-topics and are clearly formulated.

Second, according to experts, the pedagogical aspect is categorized as "very valid." It indicates that the suitability of the material with basic competencies and indicators of competency achievement is following the science syllabus in junior high school. There is a POGIL learning syntax that is clearly and systematically formulated and is equipped with indicators of science process skills and the correlation between them is the main identifier of this aspect. All POGIL model syntax has been formulated in completed in every learning activity. In addition, assignments and activities can encourage students to develop aspects of science process skills.

Third, according to experts, the media aspect is categorized as "very valid". It indicates that the e-module cover design is attractive and easy to read. The cover illustration depicts the e-module content. And, the colour layout elements are harmonious and clarify the function. In addition, most of the e-module content layout consistency is very well designed and systematic. Moreover, the typography of the e-module is simple, and the use of letters in the e-module is easy to read. In terms of presentation, most of the images are presented with good colour and quality based on clear reference sources. In terms of language, it uses language appropriate to the level of development of students, simple, and easy to understand. And, most of the terms and symbols are formulated consistently.

In general, based on the results of the e-module feasibility assessment (Table 2), the developed e-module is feasible to use for the next stage, namely the trial assessment phase. The results of the validity of the e-module based on the POGIL model, in Table 2, show the average score of 91.6%, 88.9%, and 89.8% for material, pedagogical, and media aspects.

In addition to assessing the products that have been developed, the three expert validators also provide suggestions for improvements to improve product quality. The input and suggestions from the validator will be used by researchers to make revisions to support product improvements so that they are suitable for use (Utami, et al 2019; Sudiarman, et al 2015). Research on the development of e-modules based on the POGIL model has been designed and improved according to suggestions that have been made to the material, namely adjustments to more concrete illustrations and evaluations with appropriate indicators of science process skills. The pedagogical content is to adjust the learning activities with the required process skill indicators. On the media content were made in displaying images with better quality. All inputs from experts to obtain results, as presented in Table 2.

Thus, the e-module based on the POGIL model is very valid and feasible for use in the science learning process in junior high school based on the validation results of the material, pedagogical, and media. Hopefully, this e-module can be used to train students' science process skills. In addition, this e-module can be used according to its function.

CONCLUSION

The science e-module based on the Process Oriented Guided Inquiry Learning (POGIL) model was declared very valid and feasible for students. Then, this e-module can be used in science learning, especially regarding vibration, waves, and sound topics in junior high school. Thus, the e-module based on the POGIL model is expected to be able to train students' science process skills and be tested on junior high school students at a next stage.

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