Development of Process Oriented Guided Inquiry Learning-based E-Module to Improve Critical Thinking Skill

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Abstract: This study aims to determine the feasibility of a POGIL-based e-module to empower students’ critical thinking skills. The type of research used is research and development with research procedures using ADDIE (Analysis, Design, Development, Implementation, Evaluation) model development. This research is limited to the feasibility test of POGIL-based e-modules at the development stage. The assessment of the validity test results and the questionnaire practicality test were interpreted on a Likert scale. Based on data analysis, the following results were obtained: validity tests by POGIL-based e-module learning media obtained an average of 88.3% for media validity, 96.6% for the validity of the material, and 87.5% for Language validity. Practicality tests conducted by teachers get an average of 84% and students by 90.6%. Based on the validity and practicality test of POGIL-based e-module learning media to empower students’ critical thinking skills, they are declared feasible to be used for further research.

Keywords: E-Module; POGIL; Critical thinking skill

Introduction

21st-century knowledge skills is learning and innovation skills (Trilling & Fadel, 2009). Learning and innovation skills include creativity, collaboration, communication, problem-solving, and critical thinking (Lu & Xie, 2019). Critical thinking skills are the ability of students to express reasons both orally and in writing (Živković, 2016). Critical thinking skills have six components: interpretation, analysis, inference, evaluation, explanation, and self-regulation (Facione, 2015).

Critical thinking skills are competencies that students need for personal and professional life. Critical thinking is a process, as well as its acquisition takes time. In this process, teachers must realize the need for transformations to adapt their teaching methodology to their students’ learning (Bezanilla et al., 2019). Think critically about building arguments and influencing life and the future (Ravista et al., 2021). Critical thinking is a process that is contextual and manifested through a pedagogical context (Danvers, 2019). Dekker (2020) also states that students’ critical thinking skills often assume each discipline reveals in various aspects of the possible solution to the problem and produces the complete answers necessary to combine all these insights. Critical thinking students develop the idea that the truth or explanation of a problem cannot always be well explained from one particular perspective (Utami et al., 2022).

The PISA (Programme for International Student Assessment) study in 2018 showed that Indonesia ranked 71st out of 79 countries. PISA evaluation includes performance in reading, science as well as mathematics. Assessment of the potential performance of science years obtained an average score of 396, so it decreased higher in 2015 by obtaining an average score of 403. Students can clearly understand scientific phenomena that occur. From understanding knowledge, it will be used as an identification, in a general case, in the assessment of scientific performance ability. The low results of the survey from PISA in 2018 show that there must be a review and improvement of education in Indonesia that can compete to improve quality of education. From the results of the survey from PISA in 2019, it can be seen that the critical thinking of students in Indonesia must be a review and improvement of education in Indonesia that can compete to improve quality of education. From the results of the survey from PISA in 2018, it can be seen that the critical thinking of students in Indonesia.

How to Cite:
Critical thinking is a process, and its acquisition takes time. In this process, teachers must realize the need for transformations to adapt their teaching methodology to their students’ learning (Bezanilla, M. J., Fernández-Nogueira, D., Poblete, M., 2019). The use of learning models can help adjust teaching methodology. One learning model that can accommodate critical thinking skills is POGIL (Process Oriented Guided Inquiry Learning). The POGIL model is based on the principle of constructivism that can make students more active with the existence of group interactives as problem-solving (Syafei & Mawardi, 2022). POGIL is teaching that focuses on students by doing it in groups aimed at mastering a concept of non-memorization. Students are also expected to improve assessment, management, teamwork, communication, metacognition, high-level thinking, and critical thinking skills (Hanson, 2006).

In addition, the way to improve critical thinking skills is to develop teaching materials such as electronic e-modules (e-modules) (Pierce & de Man, 2019; Rajaguru et al., 2020; Wahidah et al., 2019). E-modules have strategic value in practicing critical thinking skills. Pierce & de Man (2019) states that critical thinking in biology learning can be developed using literature in the form of e-modules.

Based on the background of the problem and the results of preliminary observations, researchers developed a POGIL-based e-module learning media to empower students' critical thinking skills.

Method

This research is a research and development. The basis for the development of this research uses the ADDIE model owned by Branch (2009). The ADDIE model consists of five stages: analysis, design, development, implementation, and evaluation (Branch, 2009). However, this publication is limited to the analysis, design, and development stages. The ADDIE model can be viewed in Figure 1.

The validity test in this study consists of media experts, material experts, and linguists. The aspects assessed in the validity test to media experts are program purpose, program guide, program purpose, interface, and wear and durability. The aspects assessed in the validity test to the material expert are introduction of E-Module, learning, content, evaluation, and additional part. The aspects assessed in the validity test for linguists are correct, terminology, clarity, and suitability.

The Practicality Test in this study was aimed at teachers and students to respond to the development of POGIL-based e-module media. The aspects assessed in the teacher practicality test are convenience, interest and motivation, self-learning, critical thinking and problem solving, and contextuality. The aspects assessed in the

\[ P = \frac{\sum X_i}{\sum X} \times 100\% \]

(1)

where:
- \( P \) = Ranking percentage
- \( \sum X_i \) = Scores given by expert validators
- \( \sum X \) = Maximum Score

The overall feasibility percentage results of the components used for decision-making are whether or not they are suitable for use in POGIL-based e-module learning media. The decision-making categories of validity tests and practicality tests can be seen in Table 1.

<table>
<thead>
<tr>
<th>Category</th>
<th>Score %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>76 - 100</td>
</tr>
<tr>
<td>Good</td>
<td>51 - 75</td>
</tr>
<tr>
<td>Not Good Enough</td>
<td>26 - 50</td>
</tr>
<tr>
<td>Bad</td>
<td>0 - 25</td>
</tr>
</tbody>
</table>

The validity test in this study consists of media experts, material experts, and linguists. The aspects assessed in the validity test to media experts are program guide, program purpose, interface, and wear and durability. The aspects assessed in the validity test to the material expert are introduction of E-Module, learning, content, evaluation, and additional part. The aspects assessed in the validity test for linguists are correct, terminology, clarity, and suitability.
student practicality test are organization, legibility, attractiveness, cohesiveness, and critical thinking.

**Result and Discussion**

Based on the initial needs analysis, the learning media commonly used by teachers are not supportive of empowering students' critical thinking skills. Teachers only use videos and PowerPoint as learning media. The results of the analysis of teaching materials that teachers use include print modules and textbooks, showing that both are compiled in general and do not contain the steps for implementing a learning model. In addition, the results of the analysis also show that both modules and books have not been empowered to practice critical thinking skills.

In the learning process, teachers have not applied e-modules to students, and a POGIL (Process Oriented Guided Inquiry Learning) based teaching model because there are obstacles in this learning model. It is difficult to stimulate student activities; not all students are active. In POGIL, student-focused teaching that invites students to be more involved in learning activities and investigate more deeply about a topic.

Based on the initial needs analysis, the researchers carried out the development of a POGIL-based e-module. The POGIL-based e-module aims to empower students' critical thinking skills. The material contained in the e-module is adjusted based on the syntax of the POGIL learning model.

Development is carried out using tools in the form of software and hardware. The software used is Visual Studio Code version 1.167.1 and Corel Draw version X7. The hardware is a laptop with an Intel Core i5 5th Gen CPU processor @ 1.60 GHz 2.30 GHz, 4GB RAM, Android smartphones, and IOS.

POGIL-based e-module learning media comprises front pages, introductions, about, competencies, instructions for use, concept maps, learning activity menus, POGIL learning syntax, orientation, exploration, concept formation, application, and credit. The front page contains student information to log in to the e-module feature. The front page of the POGIL-based e-module can be viewed in Figure 2.

The introductory page contains a brief explanation of the POGIL-based e-module. The initial page can be seen in Figure 3.

The about page contains a brief description of the material and parts of the e-module. The about page can be seen in Figure 4.

The Competency page explains the core competencies and basic competencies according to the 2013 curriculum. The competency page can be viewed in Figure 5.

The e-module usage instructions page is listed at the beginning to make it easier for users to operate the e-module. The instructions for the use page can be seen in Figure 6.
The concept map page summarizes the material presented in the e-module based on the 2013 curriculum. The concept map page can be seen in Figure 7.

The learning activities menu page contains sub-materials that will be studied in one chapter taught. The learning activities menu page can be seen in Figure 8.

The POGIL learning syntax page consists of orientation, exploration, concept formation, application, cover, and material. The POGIL learning syntax page can be seen in Figure 9.

The orientation page contains the problems presented to realize a responsive learning situation. The orientation page can be seen in Figure 10.

The exploitation page contains the formulation of the problem based on the issue presented in the orientation section. The exploration page can be viewed in Figure 11.

The concept formation page demands that students conclude precisely, assisted by the questions presented. The concept formation page can be seen in Figure 12.
The application page is a reinforcement of the concepts that have been compiled previously. The application page can be seen in Figure 13.

The closing page reflects the discussion results in the previous stages, which an evaluation from the teacher will assist. The closing page can be seen in Figure 14.

The material page contains a summary of the material of the sub-material studied for each learning activity. The material page can be seen in Figure 15.

The credits page contains a bibliography and glossary that users can use to obtain additional information appropriate to the material. The credit page can be seen in Figure 16.

One of the tools in the learning process is learning media (Hartini et al., 2017), and learning must-have media innovations that keep up with the times (Mukhadis et al., 2021). One of media is web-based e-module (Hendri et al., 2021). Each individual must currently have the literacy of mastering information technology, information literacy, knowledge and literacy skills of digital, and critical thinking skills (Lu & Xie, 2019). Thus, learning media are needed to accommodate the essential empowerment of thinking skills. In addition, the way to improve critical thinking skills is to develop teaching materials such as electronic e-modules (e-modules) (Pierce & de Man, 2019; Rajaguru et al., 2020; Wahidah et al., 2019).

The validity test of media experts consists of four aspects, namely program guide, program purpose, interface, wear, and durability. The results of the media validity test can be seen in Figure 17.
Based on the results of the validity test above, the material listed on the POGIL-based e-module learning media received 100% results in the introduction aspect, 98% in the learning aspect, 96% in the content element, 89% in the evaluation, and 100% in the additional part aspect. The overall average of the measured aspects reached 96.6%, with the excellent category. The material validity test is declared valid after testing by a material expert.

Language is one of the ways of delivery used in e-modules (Sofyan et al., 2019). The language in learning must be by the material being taught (Berardo, 2006). Language Usability is the main tool when e-modules are used as self-study advice (Kossioni et al., 2013).

The language expert validity test consists of four aspects: correct, terminology, clarity, and suitability, which the linguist validator assesses. The results of the language validity test can be seen in Figure 19.
The validity test conducted for POGIL-based e-module learning media obtained an average of 88.3% for media validity, 96.6% for the validity of the material, and 87.5% for Language validity. Practicality tests conducted by teachers get an average of 84% and students by 90.6%. Based on the validity and practicality tests that researchers have carried out, POGIL-based e-module learning media products to empower students’ critical thinking skills are declared feasible to be used for further research.

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