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Development of Biology E-Module Based on POGIL in Virus and Bacteria Material to Train HOTS X Graders of Senior High School

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ABSTRAK

Higher Order Thinking Skill (HOTS) merupakan keterampilan yang perlu dimiliki setiap individu untuk dapat menyelesaikan masalah yang dialami secara cepat, kritis dan logis. Realitanya kondisi *HOTS* di Indonesia masih rendah. Penelitian ini bertujuan untuk membuat dan menilai kelayakan E-modul biologi berbasis POGIL pada materi virus dan bakteri. Penelitian ini menggunakan model pengembangan 4D *(Define, Design, Development, and Disseminate*), namun dibatasi pada tahap *Development*. Sampel uji coba produk pada 42 siswa IPA kelas X diambil secara acak. Hasil validasi dari ahli media, ahli POGIL, ahli materi, ahli bidang HOTS, serta guru biologi yaitu, 83,3%; 85%; 82,5%; 86,2%; serta 88,6%. Keseluruhan hasil dari validasi ahli memiliki kualitas sangat layak. Tanggapan peserta didik terkait E-modul berbasis POGIL pada materi virus dan bakteri mendapatkan hasil sebesar 85,3% yang termasuk kategori sangat layak. E-modul memiliki kategori sangat layak diaplikasikan menjadi sumber belajar siswa SMA/MA kelas X.
Kata kunci: E-Modul; HOTS; POGIL.

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ABSTRACT

Higher-Order Thinking Skill (HOTS) is a skill that every individual needs to be able to solve problems quickly, critically, and logically. The condition of HOTS in Indonesia is still low. This study aims to create and assess the feasibility of E-module biology based on POGIL on viral and bacterial materials. This study uses the 4D development model (Define, Design, Develop, and Disseminate but is limited to the Development stage. The product trial sample on 42 science students of grade X was taken randomly. The validation results from media experts, POGIL experts, material experts, HOTS experts, and biology teachers, namely, 83.3%, 85%, 82.5%, 86.2%, and 88.6%. The overall results from the expert validation are of very decent quality. The student's responses regarding the E-module based on POGIL on the virus and bacteria material obtained a mark of 85.3%, which included the very decent category. E-module is a feasible type to be applied as a learning resource for X senior high school grades.
Keywords: E-Modul; HOTS; POGIL.

INTRODUCTION

The thinking process in the 21st-century era only occurs at the level of explaining concepts and theories but tends to be at the level of answering problems (Anggriani, Diana and Latifah, 2019). Problem solving is one of the skills of this century that requires high-level thinking abilities (Arifiyyati, Rofi'ah and Listyono, 2023). Badjeber et al., (2018) wrote that the way to achieve higher-level thinking abilities is to increase the proportion of questions oriented towards higher-level thinking abilities. HOTS can be trained through activities oriented towards a scientific approach and familiarize students with solving problems containing HOTS to increase their high-level thinking abilities. However, the teaching materials used do not include questions that can empower students to improve HOTS (Savira, Budi and Supriyati, 2019). Indonesia's low HOTS level means that Indonesian students can only answer 5% of questions containing HOTS and 78% of LOTS, while Korea has been able to answer 71% of HOTS questions (Mubarak, 2018).

The learning concept that directs students to actively process their knowledge is process-oriented guided inquiry learning (Sasmita, Medriati and Hamdani, 2021). The inquiry process aims to improve the skills of thinking, working, acting scientifically, and communicating (Rahayu, Ashadi and Utomo, 2019). The research results of Savira et al., (2019) show that POGIL can improve cognitive thinking abilities at a high level, namely Bloom's C4 taxonomy. Learning that can increase thinking and problem-solving skills is POGIL (Rahayu, Ashadi and Utomo, 2019). POGIL, which carries the student-centered concept, needs to be integrated into learning resources, such as E-modules, that can activate students in learning. According to Syafitri et al., (2019) E-modules are equipped with various questions that can provide students with high-level thinking skills in solving these questions. Fathurrohmi, (2019), confirms that electronic modules effectively empower students' higher-order thinking Skills.

Interviews with tenth-grade science biology teachers at SMA Negeri 1 Sidomulyo in Lampung did not show any use of electronic modules based on the POGIL model that could empower students' higher-level thinking abilities. This is in line with the results of a questionnaire from 95 respondents, with 90.5% indicating the need for innovation in teaching materials in the form of E-modules. Based on needs analysis, E-modules are a practical independent learning resource. This is due to the use of cell phones as electronic media, which is more dominant than books as a non-electronic source (Sasmita, Medriati and Hamdani, 2021). Students generally use printed modules, which tend to be monotonous; this results in a lack of enthusiasm for students learning so that they do not experience an increase in mastery of concepts (Herawati and Muhtadi, 2018). POGIL-based electronic modules are valid for classroom learning and can be used as student self-study guides (Cahyaningrum, Nurjayadi and Rahman, 2017). Based on this description, research entitled Development of a Biology E-Module Based on Pogil Virus And Bacteria Material For Practice HOTS Grade X Senior High School needs to be carried out.

METHOD

This research is Research and Development (R&D), with a 4D development model (Define), Design, Development, and Dissemination. The research is limited to the Development stage. The research was conducted at SMA Negeri 1 Sidomulyo on April 14, 2023. The trial was conducted on 42 tenth-grade science students at SMA Negeri 1 Sidomulyo in South Lampung. The data collection technique for this research is interviews with biology teachers at SMA Negeri 1 Sidomulyo using interview instruments given to the teacher. The questionnaire in this research is in the form of a validator questionnaire given to the validators and a student response questionnaire. Quantitative data was obtained from questionnaire scores, and qualitative data was obtained from responses and suggestions, with the following percentage formula adopted from Wahjusaputri and Purwanto, (2022).

$$\% = \frac{A}{B} \text{ X } 100\%$$

Information:
% = Percentage
A = Total Score
B = Maximum Score

The percentage score results are then combined with the validity level based on Table 1.

Table 1. Validity Category

Percentage Score	Category
0% - 20%	Very inappropriate/ very invalid/ not very suitable for use
21% - 40%	Inappropriate/ Invalid/ Not suitable for use
41% - 60%	Suitable enough/ Valid enough/ Fit enough to be used
61% - 80%	Appropriate/ Valid/ Proper to use
81 % - 100%	Very suitable/ Very valid/ Very suitable for use

(Source: Sugiyono, 2013)

RESULTS AND DISCUSSION

Experts have validated the Biology E-module based on POGIL, and the responses of grade X science students have been tested. The E-module that has been developed has been validated by media experts, POGIL experts, material experts, HOTS experts, and Biology teachers. The decentness results by the following validators are presented in Table 2 below.

Table 2. Recapitulation of Validation Results

Experts	Total Score	Maximum Score	Percentage	Decentness
Media	40	48	83,3%	Very Decent
POGIL	34	40	85%	Very Decent
Material	99	120	82,5%	Very Decent
HOTS	69	80	86,2%	Very Decent
Teacher	78	88	88,6%	Very Decent
Average			85,1%	Very Decent

Based on validation results from experts and biology teachers, the E-module is very suitable for use overall. The E-module product feasibility test aims to determine the feasibility value of the product being developed. The validation results from media experts, POGIL experts, material experts, HOTS experts, and biology teachers were 83.3%, 85%, 82.5%, 86.2%, and 88.6%. This follows Ernawati, (2017) that the valid category has a percentage of 81% -100%. The average score from the experts is 85.1%, so the E-module is "very suitable" for use as biology teaching material.

The next test is a trial of the E-module based on POGIL product by students through a questionnaire distributed online in the form of a Google form. The graph of student trials is in Figure 1 below.

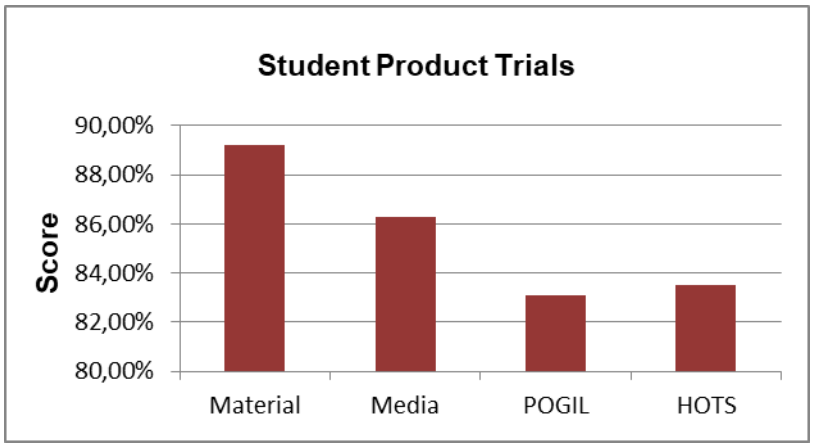

Figure 1. Graph of Student Product Trials

Based on this graph, it can be seen that the range of scores obtained from each aspect is 83.1%-89.2%, so it is included in the "very feasible" category. Validation of trials on students consists of four elements, namely material, media, POGIL model, and HOTS. The validation results from these four aspects were 89.2%, 86.3%, 83.1%, and 83.5%. The results of product trials from all aspects obtained an average score of 85.3%, including the "very feasible" category. The results of suggestions for improvement from students as subjects in the research are used as a reference for the product improvement process so that it is better and brings benefits (Irawan, 2017). According to the research results of Savira, Budi and Supriyati, (2019) e-modules based on the POGIL model are independent textbooks suitable for improving students' high-level thinking skills. POGIL can improve thinking abilities at a high cognitive level in Bloom's taxonomy categories C4 to C6 (Misbah, Wati and Anggraini, 2015).

HOTS can be achieved if students actively understand and integrate knowledge with their experiences (Anderson and Krathwohl, 2015). This can be achieved in the POGIL model components. These components are presented in one learning cycle with phases: exploration, concept discovery, and application (Sulasmi, Rati and Japa, 2018). Exploration activities in POGIL guide students to create their understanding (guided inquiry) and teachers become providers of facilities (Farda, Zaenuri and Sugiarto, 2017). According to the research results of Masnur and Syaparuddin, (2019), the level of analysis (C4) increases because students practice according to exploration

activities in POGIL. The ability of the evaluation level (C5) increases because the concept discovery activities can provide students with direct and authentic experience so that students can build and discover their knowledge. At the creating level (C6), this ability increases because it is seen that students can create new ideas or information based on what they learn through the POGIL learning model.

CONCLUSION AND RECOMENDATION

The e-module has a very suitable category so that it can be used as a learning resource for tenth-grade or senior high school students and can train HOTS. The validation results from media experts, POGIL experts, material experts, HOTS experts, teachers, and student response results were 83.3%, 85%, 82.5%, 86.2%, 88.6%, and 85%. The E-module biology that has been developed can be used as a reference for teachers in teaching in class or for students to learn independently, even up to the dissemination stage. E-Modules based on POGIL can be developed on other biological materials.

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