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Development of Predict-Observe-Explain Oriented e-Module as a Learning Media to Improve Students' Problem Solving Skills

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Abstract: This study aimed to develop POE oriented E-Module with Flip Pdf Professional to practice students' critical thinking skill on environmental changes materials which is valid, practical, and effective. The subject of this study is the students in grade X IPA5 in SMA Negeri 1 Gorontalo. This study is a research and development. The result of this study revealed that the validity test based on the expert validation analysis (content and construction) and practitioners' validation (teachers) obtained the $\bar{x}$ score respectively 96%, 95%, and 95% (very valid). Practicality test as the result of the implementation of teaching and learning, students' activities and responses obtained $\bar{x}$ score respectively 100%, 89.28%-92.85%, 95% (very practical). The effectiveness test based on the analysis of N-Gain score in a small group obtained a score as big as 0.78 (effective). It can be concluded that the POE oriented E-Module with Flip Pdf Professional to practice students' critical thinking skill is considered valid, practical, and effective to be used in Biology class for Grade X in SMA Negeri 1 Gorontalo.

Keywords: e-module, predict, observe, explain, critical thinking skills.

Abstrak: *Penelitian ini bertujuan untuk mengembangkan E-Modul berorientasi POE dengan Flip Pdf Professional untuk melatih kemampuan pemecahan masalah peserta didik pada materi perubahan lingkungan yang valid, praktis, dan efektif. Subjek penelitian adalah peserta didik kelas X IPA5 di sekolah SMA Negeri 1 Gorontalo. Jenis penelitian ini adalah penelitian pengembangan. Hasil penelitian menemukan bahwa uji kevalidan berdasarkan hasil analisis penilaian validator ahli (isi dan konstruk) dan validator praktisi (guru) mempereoleh skor* $\bar{x}$ *berturut-turut adalah 96%, 95%, dan 95% (sangat valid). Uji kepraktisan untuk hasil dari keterlaksanaan pembelajaran, aktivitas peserta didik, dan respon peserta didik mendapatkan skor* $\bar{x}$ *berturut-turut 100%, 89.28%-92.85%, 95% (sangat praktis). Uji keefektifan berdasarkan hasil analisis N-Gain score kelompok kecil bernilai 0.78 (efektif). Kesimpulannya bahwa e-modul berorientasi POE dengan Flip Pdf Professional untuk melatih kemampuan pemecahan masalah peserta didik valid, praktis dan efektif digunakan dalam pembelajaran Biologi dikelas X SMA Negeri 1 Gorontalo.*

Kata kunci: *modul elektronik, predict, observe, explain, keterampilan pemecahan masalah.*

▪ INTRODUCTION

Education is a process in shaping and developing students' reasoning skill, competences and moralities. Education is also an attempt to develop students' potential capabilities to become a human with characters, knowledge, skillful, creative, independent and high competitiveness to encounter global competition by mastering technological advancement (Marisa et al., 2020; Thahir et al., 2020). The manifestation of education is supported by the process of teaching and learning. A quality teaching and learning do not only involve students but also teachers' role and the availability of the assisting tools in it. Teacher has a pivotal role in creating an effective teaching. They do not only function as the source of knowledge but also motivator in developing

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students' skills and interest as efforts in seeking knowledge independently. Teacher as a facilitator is encouraged to mind the supporting tools in the teaching process by following the progression of information and communication technology nowadays so that they can provide interesting tools that ease the students in understanding the learning materials (Duengo et al., 2020; Hamid, 2020). The supporting tools used in the teaching and learning is called learning media (Majid, 2020).

Teaching media is a kind of facility that can send a message and learning information that can stimulate thoughts. A well-developed learning media will be strongly helpful for students to reach the learning goals (Sahara et al., 2019; Ramdhani & Hilmi, 2015). Besides the use of learning media that can support the learning process, the teaching model can also support the execution of learning activities that can affect students' active participation and learning motivation so that it can help the teachers to practice students' skills (Latjompoh & Bau, 2021; Nurhidayati et al., 2018).

The importance of a media used in a learning activity should adhere to the advancement of technology and be oriented towards a teaching model that can assist students in practicing their skills (Hanif et al., 2019). One of skills that should be mastered by the students is problem solving skill. Considering its importance in real life, students are highly encouraged to possess this skill as they will face various problems that urge them to find solutions Muzil et al., 2022). One of learning materials in Biology discussing the environmental problems is Environmental Changes. In this materials, students are expected to practice their problem solving skill through the environmental problems discussed. Based on the interview result with one of Biology teachers in SMAN 1 Gorontalo, in teaching Biology, particularly in environmental change material, the media had been used in the form of *Power Point* and printed module. Yet, it is realized that it has not sufficient in practicing students' problem solving skills in Online classes (independent) during the pandemic of Covid-19.

Based on the facts aforementioned, an effort in developing learning media which is oriented towards a learning model that can practice students' problem solving skill particularly on environmental changes materials is needed. In this material, students will face various environmental problems. One of examples is climate change. It is one of environmental problems that often happened due to global warming caused by the increase of glass house gas emission, which was generally known to be caused by humans' activities (Baderan, 2017). The discussion on such environmental problems urge the students to make a problem solving in the learning process as an attempt in providing solutions for environmental improvement. Providing learning media should also pay attention to the advancement of communication and information technology that can support both online and offline learning process.

Previous research by Kasih et al (2021) on developing a POE-based e-module could help students to be active and independent in solving the real life problems in Chemistry class. Other research conducted by Nia et al (2022) concerning the development of e-module in conserving the environment by using Flip PDF Professional could help students and attract their attention to learn independently by using a practical e-module. Considering the previous research, the author of this research intended to do similar research as an attempt to solve problems found in learning process based on the ground observation that focuses on practicing students' problem solving skill on environmental change materials. This research is different from the previous research as it combined the use of a module and take the advantage of the application in delivering the learning media. The media developed in this study is an e-

module which is oriented to Predict, Observe, Explain (POE) learning model by taking the advantage of the advancement of technology by using Flip PDF Professional. POE is a problem solving activity that lets the students to predict, observe, and explain to solve the problems (izza, 2017). The application of Flip PDF Professional can make an interactive book pages by inserting the multimedia asset such as pictures, video from YouTube, MP4, audio-video, quiz, and this application can be used easier because it can be operated by beginner users (Seruni et al., 2020).

The purpose of this research is to develop an e-module which is oriented to POE by using Flip PDF Professional to practice students' problem solving skills focusing in the environmental change materials. The specific goal of this research is to figure out the validity, practicality, and effectiveness of the e-module developed in this study.

▪ METHOD

It is a research and development (R&D). The stages of this research referred to the research and development (R&D) modified by Sugiyono (2018). The initial step of this research is collecting information, materials analysis, student analysis, and literature study. The second stage of this research is the development of the first draft of the e-module which was followed by validation step and then revision on the second draft of the e-module. The final step of limited tryout (small scale) would obtain valid, practical, and effective e-module**.** This research was conducted in SMA Negeri 1 Gorontalo, Kota Timur, Gorontalo City. The research was conducted from January to March 2022.

The instruments used to collect the data in this research are listed in the following: a) Interview instrument with the Biology teacher; b) E-module validation instrument for expert validators (content and construction) and practitioner validator (teachers); c) Students' response instrument towards the e-module; d) Learning implementation instrument; e) Observation instrument for students' activity; f) Assessment instrument (pre-and post-test). Data collection technique employed in this study is: a) Interview with one of Biology teachers for grade X in SMAN 1 Gorontalo by using interview guide in the preliminary study; b) Validation instrument to reveal the validity of the e-module; c) Questionnaire, used to collect information on responses/assessment from the e-module which had been developed to figure out its practicality; d) Test. The test employed in this study is pre- and post-test to elicit students' learning result.

The data analysis technique in this research consists of 3 kinds, i.e. the analysis of experts' validation, the practicality of the e-module, and the effectiveness of the e-module. Data obtained from the validation of POE oriented e-module in the form of qualitative- and quantitative-descriptive data. The quantitative descriptive data were from validators' suggestions and comments. The quantitative data were from the assessment aspects using check-list (√). Practicality analysis of the POE-oriented e-module obtained from students' activity analysis, the learning implementation and the responses of the questionnaire administered to students. The level of achievement of the criteria for the percentage of validity and practicality of the POE-oriented e-module is a percentage of 81%-100% with the criteria of "very valid and very practical", the percentage of 61%-80% with the criteria of "valid and practical", the percentage of 41%-61% with the criteria of "enough valid and quite practical", the percentage of 21% - 40% has the criteria of "less valid and less practical", the percentage 0-20% has the criteria of "invalid and impractical" (Permatasari, 2018). The data obtained from the validation and practicality results were analyzed using the percentage data analysis technique using the following formula:

$$V = \frac{TSE}{TSM} \times 100\%$$

Analysis of the effectiveness of e-modules consist of 2 aspects namely the learning outcome test (problem solving analysis) and N-Gain analysis. For the category of student problem-solving ability, if the grade obtained is between 85.00 - 100 then it belongs to the category "Very Good", if the value obtained is between 70.00 - 84.99 then it belongs to the category "Good", if the value obtained is between 55.00 - 69.99 then it belongs to the category "Fair", then it belongs to the category "Poor", and if the value obtained between 0 - 39.99 then it belongs to the category "Very Poor" (Mawaddah et al., 2015). The N-Gain analysis applied a formula as delivered below and the effectiveness criteria of the e-module, if the average value of Normalized Gain ≥ 0.70 then it includes "effective" or “high category”, if the average value of Normalized Gain ≥ 0.30 and < 0.70 then it includes "quite effective" or “medium category”, and if the average value of Normalized Gain < 0.30 then it includes "less effective" or “low category” (Zheng, 2015).

$$\text{N-Gain} = \frac{posttest\ score - pretest\ score}{maximum\ score - pretest\ score}.$$

▪ RESULT AND DISCUSSION

E-Module Validity

The e-module developed in this study discusses all sub materials in environmental changes involving the environmental change, factors causing the environmental change, effects and solution as the manifestation in conserving the environment where the changes happened. Materials delivery in the e-module has a distinct characteristic in which the activities referred to problem solving activities based on the syntax of POE learning model. There are three steps. First is predicting. In this stage, students are asked to make predictions towards a phenomena or problem. Students predict the answers from a problem given, and write the prediction completed with the reason. Students compose the initial prediction based on their background knowledge. In the second step that is observing, students are asked to observe what is happening. Students do an observation both directly and indirectly (through an experiment or literature review). Students record what they observe and relate their previous prediction to the observation result they obtained. The third step is explaining. Students give explanation on the suitability between their predictions with the observation result which had been done. Thus, the students are able to explain why the prediction and the observation result correct or incorrect (Rini et al., 2019; Dewi et al., 2020).

Prior to the try-out, the e-module developed in this study was initially validated. Validation aims at producing a valid and fruitful e-module for learning process. The e-module was validated by two expert validators from the lecturer (content and construction) in which each validation observed and assessed 19 aspects. The practitioner validator is a biology teacher from SMAN 1 Gorontalo in which the aspects of validation consists of 21 points. The assessment result was conducted before the revision. The validation score of the e-module was categorized “fairly valid”. According to the expert validators’ comments about the content and construction especially on the content appropriateness, the details must be completed with complete and updated materials. Further, assignment must be delivered in the activity of Predict, Observe, Explain (POE) by referring to the environmental problem existed around Gorontalo city.

In terms of design, the message of the video and pictures were considered less valid and not in line with the learning objectives of the e-module. The validation of a learning media must cover several aspects of assessment such as content, materials delivery, language, and organization appropriateness (Serevina et al., 2018).

The results of the analysis of the validation of the e-module POE material Environmental changes, for content validation an average score of 96%, construct validation an average value of 95%, and teacher validation an average score of 95% the three results are included in the criteria "Very Valid". It can be stated that the POE-oriented e-module of this study is worth to be used for learning process. This is relevant to the research result by Latjompoh, et al. (2019) which revealed that the validation of a learning media obtaining average score as big as 81.25%-97.2% was categorized "very valid" and worth to be used by teachers to support the learning activities at school. The validation result on materials (content) with percentage 90.91% and 90.63% was each categorized "Very Valid" so that it can be concluded that the e-module developed in this study is worth to be used as a learning media (Minar & Yustina, 2020).

The results obtained from the e-module validate that the value by validators is excellent. As for some things that support the achievement of the value of the vaidan namely, the e-module developed is said to be very good because it meets all aspects in terms of the material it is seen that the developed e-module contains independent aspects and independent learning. in addition, based on comments from validators that the e-module contains interesting aspects of the display with clarity of simple, communicative, and clear use of language, communicative and clear presentation of environmental problems provided, making it easier for students to understand the material and practice problem-solving skills. E-modules are designed with aspects of independence in the process of use and contain user-friendly and active aspects that can make students more familiar with their use by using grammar and sentences that are easy to understand, clear, and communicative, and can encourage learning motivation, improve students' understanding of the material and have a positive impact on satisfaction with their learning behavior (Noroozi & Mulder, 2017; Perdana et al., 2017).

E-Module Practicality

1. The Implementation of Learning (Teachers' Activity)

To reveal the test result on the implementation of learning, checklist which had been adjusted to the syntax of the lesson plan and developed e-module was administered. The assessment on the implementation of learning is considered highly important because it relates to the achievement of the learning process in the classroom. The assessment on the implementation is considered successful if the score obtained is categorized very good and excellent (Widiyanto et al., 2021). The result on the implementation of learning which is suitable with the recapitulation conducted in grade X IPA^5 for three times each obtained score as big as 100% with implementation percentage as big as $P \geq 90\%$ which was categorized "excellent". This was due to all aspects of the learning implementation had been conducted based on the learning steps provided in the lesson plan. This echoes the research result by Aditama (2016) in which the percentage of the learning implementation reached 95.84% which was categorized excellent and the learning implementation was considered suitable with the syntax in the lesson plan so that the execution of the learning activity could run smoothly. If the

learning implementation gained a criterion "very practical" this means that the developed e-module is easy to use and user friendly (Husna & Zuwida, 2021).

2. Students' Activities

To reveal students' activities, checklists consisting 7 observation aspects during the implementation of learning were administered. The observation result on students' activities were conducted during three meetings. The first meeting observation gained 92.85%, second meeting 89.28%, and third meeting 92.85%. The average of these score was 91.66% which was considered "excellent". According to Akbar & Razak (2019), the analysis result of students' activities for three meeting with percentage as big as 85% was categorized excellent. In the second activity, the students' performance was decreasing if compared to the first and third meetings. This happened due to some students who were passive in giving responses during the apperception and drawing the learning conclusion. These two aspects strongly influenced the learning process in achieving the learning goals as by seeing these two aspects, teacher can figure out students' level of understanding towards the materials given. One of the learning goals is making the student capable of drawing conclusion related to the materials taught (Triwahyuningtyas et al., 2021).

Students' activities improved during the learning process because the module was made appealing by delivering pictures, videos, and audio information based on the environmental problems so that the students can be more motivated and interested in initiating a discussion with their peers in a group. The supporting pictures that make the materials clearer is required as it can explain the materials better, the picture or symbols can increase the attractiveness of the media which at the same time could minimize boredom among the students to learn with the e-module (Purwanto, 2020).

3. Students' Responses

Practicality can be seen through students' responses towards the POE-oriented e-module developed in this study through the questionnaire after the students used the e-module in three meetings with three aspects and ten questions. The total score was 570, if converted to percentage of this score it reached 95% which was categorized "very practical" from 15 students giving positive responses towards the POE-oriented module with Flip PDF Professional to practice their problem solving skill. The criteria of product developed in this study is considered "very practical" if the percentage of students' responses was between 81% - 100% (Nikmah & Mintohari, 2019). This is in line with the research result by Bachri et al. (2021) that students' responses towards the e-module with a percentage as big as 92% which was in the range of $80\% \leq RS \leq 100\%$ implied positive responses from the students. Based on the result of students' responses towards the POE-oriented e-module, it was considered really helpful in understanding the materials particularly in sharpening their problem solving skill on the environmental change material. In addition to that, the e-module provides pictures, video, and audio information related to environmental problems that happened in their surrounding which is completed with the assignment in the e-module which refers to the problem solving activity. According to Vida (2015), POE-oriented learning is considered as an efficient learning to practice and improve students' conception and problem solving skill. Other positive comments from the students towards the e-module reveal that the module can motivate them to learn as it is easy to use and the appearance of the module is attractive

for them. Attractive appearance of a learning media can affect students' interests to lean (Pratiwi, 2018).

E-Module Effectiveness

1. Students' Learning Result (Problem Solving Skill Analysis)

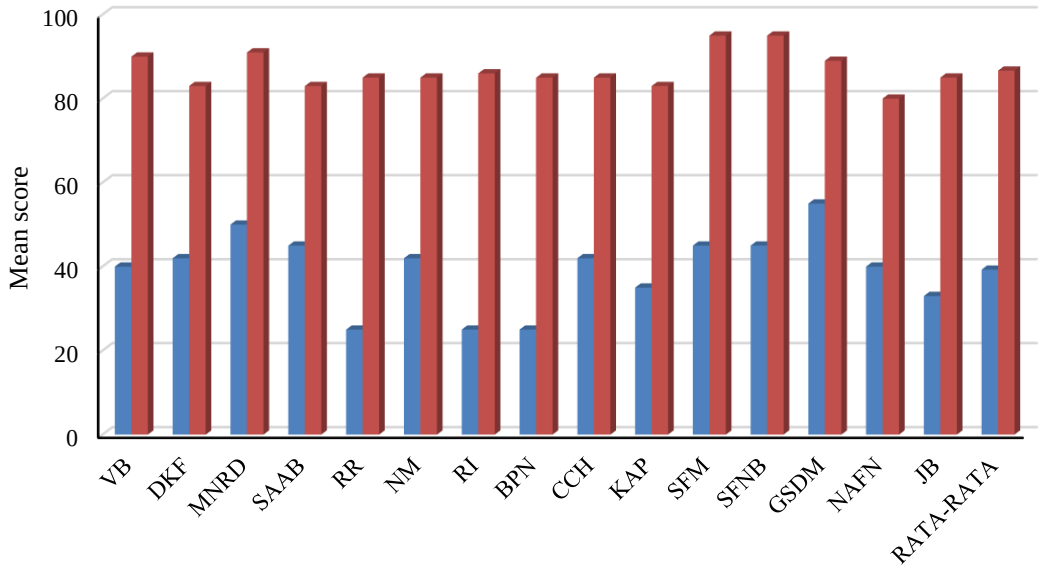

Figure 1. Graphic on the Result of Students' pretest (blue) and posttest (red)

The evaluation result on students' problem solving skill according to the pre- and post- test scores revealed that 100% of the pre-test score was considered failed with the lowest score 25 and the highest score 55. While the post test scores of the students were 100% considered pass with the lowest score 80 and the highest is 95 with the minimum passing grade 75 as set by SMA Negeri 1 Gorontalo. Students' fail result in the pre-test was caused by their low problem solving skill on environmental changes material. Based on the lowest score that is 25, students were considered had not fulfil the problem solving aspect, particularly in identifying the factors causing the environmental problems, the effects and alternative solutions towards the provided environmental problems. The highest score is 95 which means that the students has fulfilled the problem solving aspects. The indicators of problem solving skill are such as identifying problems, looking for alternative solutions, and evaluate the result of problem solving (Anjarwati, et al., 2018).

Based on the acquired score in pre- and post-test, it can be seen that there was an improvement on students' learning result, where the average score of the pre-test before implementing the e-module in the learning process was 39.26 which was categorized "very poor". While the improvement of the average score on the post-test after implementing the e-module in the learning activity reached 86.66 with problem solving skill criteria "excellent". According to Sugiani et al (2019) a score ranging from 38.00 – 60.00 is considered "poor" while 70.00 – 85.00 is considered "good". It shows that the POE-oriented e-module has made a better impact towards students' problem solving skill considering the passing grade of students on the pre-test that showed 100% fail and the post-test 100% pass. According to Purwanto (2020), the effectiveness can be seen as the impact or result of an action. In this case, the impact of the use of e-module can be

seen through the learning result. There are several factors affecting students' problem solving skills one of which is the learning media used in the learning process (Sintawati & Gede, 2021).

2. N-Gain

The results of the n-gain analysis of learners in general on limited trials (small scale) were in the range of ≥ 0.70 which included "high" with the level of interpretation of effectiveness being at the prersentase of the average value of ≥ 76 criteria "effective". This is in line with a study by Edi et al (2022) where the improvement on the learning result is calculated with N-Gain that generated a score < 40 with criteria "not effective" and the percentage (%) of N-Gain score as big as > 76 which was categorized "effective". N-Gain test was conducted to figure out the improvement of the learning result before (pre-test) and after (post-test). Thus it can be concluded that there is an improvement on the learning result by implementing the POE-oriented e-module which was categorized high and the e-module is considered effective as it gives good impacts towards students' learning result (Ramadhana & Hadi, 2022; Purwanto et al., 2020).

CONCLUSION

Based on the research result, it can be concluded that validity test based on the analysis of expert validation (content and construction) and practitioner validation (teacher) had reached $\bar{x}$ score respectively 96%, 95%, and 95% (categorized "very valid"). Practicality test on the result of the learning implementation, students' activity and responses had reached $\bar{x}$ score respectively 100%, 91,66%, 95% (categorized "very practical"). The effectiveness test based on the analysis of N-Gain score in small scale reached 0.78 (categorized effective) after being used for teaching and learning in Biology class of SMAN 1 Gorontalo. Based on the result of this study, it can be concluded that the POE-oriented e-module with Flip PDF Professional to practice students' problem solving skill could fulfill the criteria of valid, practical, and effective so that it is appropriate to be used for learning biology particularly for environmental changes material for grade X of senior high school.

The e-modules developed in this study are limited to limited trials, so further research is needed with extensive trials with the implementation in some schools. In the field of education, this e-module provides an impact that can make it easier for learners to understand the material specifications and can improve learners' problem-solving skills through environmental problems learned in poe-oriented e-modules on environmental change materials

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