KnE Social Sciences
ICMScE
International Conference On Mathematics And Science Education
Volume 2024

Research Article

# Development of a STREAM-Based Self-Study Module to Stimulate HOTS in Petroleum Study Materials

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**Abstract.**
This study aimed to develop a STREAM-based self-study module to stimulate HOTS in petroleum study materials and to test the effectiveness of the module. This developmental research used the 4D method. This research began with a literature study and observations of class XI MIPA students to see the material used and the learning process, as well as to find out the obstacles to learning. The initial conditions provided ideas for making STREAM-based self-study modules that are expected to stimulate students' HOTS. The module was tested on a limited basis on online classes of XI MIPA 3 to see its practicality. In completing the module, an expert feasibility test was carried out. The expert test showed that the STREAM-based learning module to stimulate HOTS was in the very appropriate category with an average score of 94.55%. For the very decent quality category with a value of 93.13%, for the learning quality category, it was in the very feasible category with a score of 94, 28%., and 96.25% in the very decent category for technical quality (media). The very feasible category was at 96.67% for student readability. The use of STREAM-based self-study modules to facilitate HOTS was proven to be effective and can be used in the learning process. In modules with the STREAM approach to learning chemistry, students can develop independent learning skills and higher thinking skills.

**Keywords:** STREAM-based self-study, HOTS, petroleum

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**Published:** 3 April 2024

Publishing services provided by Knowledge E



Selection and Peer-review under the responsibility of the ICMScE Conference Committee.



## 1. INTRODUCTION

The development of teaching materials will create an atmosphere of a pleasant learning process. Learning activities will be more efficient, effective, and in accordance with the need for good teaching materials. This improvement in the quality of learning can certainly be supported by teaching materials. One of the chemistry teaching materials that can be used to assist the learning process is a module. The module aims to enable students to learn independently and also to improve higher-order thinking skills without a teacher [1].The purpose of developing the module is to help students minimize difficulties in the learning process, find effective ways of learning, and foster motivation

in learning to think at higher levels. The module as one of the media has several characteristics, namely the nature of the material contained in the complete module, self-study, ease to use and friendly to the user, and independence so that it does not require other tools [2].

The pandemic period caused the teaching and learning process at MAN 3 Pekanbaru City to change to online. This creates new problems in learning chemistry so that the quality of students' understanding and higher-order thinking skills decreases. Observations on learning chemistry XI MIPA 3 at MAN 3 Pekanbaru City using LKS through E-Learning showed that the learning outcomes were not satisfactory. The worksheets used by the teacher have not been able to create self-study and higher-order thinking skills [3].

The low reasoning ability of students shows a low level of higher-order thinking skills [4]. HOTS requires a thought process that is not just memorizing and presenting or reciting known information. The ability to connect, manipulate, and transform existing knowledge and experience to think critically and creatively in an effort to make decisions and solve problems in new situations is a hallmark of HOTS [5]. This higher-order thinking ability occurs when students are able to connect and transform the knowledge they already have into new problems in learning. One of the higher-order thinking skills that can be improved during the learning process is critical thinking skills. The low critical thinking ability of students can be seen in their curiosity in finding information, students tend to be passive, students are shy to ask questions and do not dare to express opinions, and just wait for the teacher. The development of higher-order thinking skills and abilities can be trained through good modules [6].

STREAM (Science Technology Religion Engineering Arts and Mathematics) is a learning approach developed from STEM that integrates science, engineering design, the use of technology related to religious aspects, as well as aspects of art and mathematics. The implementation of STREAM will certainly complement the 5 pillars of education in Indonesia in order to realize national education, namely Learning to know, Learning to do, Learning to be, Learning to live together in peace, and Learning to hope, taqwa, and Learning noble character [7]. The STREAM approach requires teachers to play a role in designing learning, interacting with students, making learning strategies, assessing students transparently, and discovering students' uniqueness. Students as learning objects play a role in learning new concepts, thinking, expressing ideas, asking questions, conducting simple research, applying learning outcomes through actions, conducting social interactions, and applying religious aspects to improve character education [8].

The chemistry learning process must be able to create a meaningful atmosphere and involve students directly. STREAM learning strategy will make students active and creative and develop soft skills. STREAM approach in learning chemistry, students can develop independent study skills and higher thinking skills [9]. The self-study material developed in this research is petroleum material to improve STREAM-based high-level thinking skills. The selected petroleum material is a material that is difficult to reach, this material is related to real life [10]. The development of STREAM-based modules on petroleum materials takes into account current conditions. In preparing this module for self-study and stimulating HOTS, it is designed to connect earth subject matter with the real world and increase level thinking skills [11].

## 2. RESEARCH METHOD

This study uses 4D steps in developing a STREAM-based self-study module development model that stimulates HOTS in the learning process. The 4D model is one of the research and development methods [12]. 4D models are used to develop learning tools. The 4D model was developed by S. Thiagarajan, Dorothy S. Semmel, and Melvyn I. Semmel in 1974. The 4D model consists of 4 main stages, namely Define, Design, Develop, and Disseminate. In this study, class XI MIPA 3 was used as a place to observe field conditions. Class XI MIPA 1 as a usability test and module practicality test. Class XI MIPA 2 which was opened by 33 people as an experimental class. The data of this research were obtained from pre- and post-learning tests using STREAM-based self-study modules to stimulate HOTS on petroleum materials and questionnaires in the class [13].

The product is carried out by material experts, media experts and pre-technical tests regarding the guidelines for the preparation of modules that have been set by BSNP. STREAM-based self-study module trials that stimulate HOTS in earthquake materials were analyzed based on the descriptive data obtained. Worry. Analysis of this descriptive data with a percentage approach (%) using the following equation [14].

According to the development approach only to know the percentage (%). The quality measurement module can use the following equation:

$$P = \frac{x}{x_1} \times 100\% \quad (1)$$

# 3. RESULTS AND DISCUSSION

## 3.1. Description of Research Result Data

This development resulted in the main product of STREAM-based self-study modules that can stimulate HOTS in petroleum materials. This development module is based on Thiagarajan which divides the development stages into Define, Design, Develop and Disseminate or known 4D. The results of the development can be seen in each of the 4 D stages as follows.

1. Define

This stage does the problem in the learning process and becomes a benchmark in designing the module to be made. The preliminary study was carried out with five processes including initial analysis, student analysis, task analysis, concept analysis and formulation of learning objectives. is a stage for identifying problems that exist in the learning process and the basis for designing products in the form of modules to be made. Analysis of students and ongoing material at MAN 3 Pekanbaru City. Observations were made in Class XI MIPA 3 MAN 3 Pekanbaru City and also interviewed the needs of students and teachers. Based on the analysis of interviews and observations obtained, STREAM-based self-study module to stimulate HOTS on petroleum materials

2. Design

The module design is based on a preliminary analysis or define, by sharpening the Basic Competency analysis. This research was carried out in class XI chemistry lessons in 2013. In the process of making draft modules for modules I, II and III, which include: basic competencies, learning objectives, instructions for use, learning activities, STREAM and HOTS-based materials, assignments and exercises, tests , Success criteria, and answer keys.

Draft I

Draft I of STREAM-based self-study module to stimulate HOTS on petroleum materials consists of two learning activities. Learning activity by explaining the causes of the formation of petroleum. Learning activity II by analyzing the technique of separating petroleum fractions and their uses. This module is also structured based on the syllabus, lesson plans, and HOTS.

3. Develop

*a. Product Evaluation Results*

Product test result data includes module validation data from material experts, media experts, linguists, chemistry teachers, and peer reviews. This validation includes appropriate aspects, graphic aspects, linguistic aspects in the form of scores stored in five categories, namely very, decent, sufficient, less and less feasible. The results of the module validation on the site obtained a score of 93.13% with a very decent category. Scores were obtained from 9 aspects of content, namely: (1) coverage of the material, (2) aspects of material accuracy, (3) Aspects of relevance. (4) Presentation Aspect.

The results of the validity of the module on the presentation of a score of 94.28% are categorized as very feasible. Scores are obtained from 7 aspects of the presentation, namely: (1) physical module size, (2) skin module layout, (3) skin module topography, (4) module skin illustration, (5) module layout layout, (6) topography content of the module, (7) illustration of the content of the module. The results of the validity of the module according to language obtained a score of 96.25% which is categorized as very feasible. Scores were obtained from 8 aspects of language and images, namely: (1) communicative, (2) dialogic and interactive, (3) adjustment to Indonesian.

Table 1: Assessment results of STREAM-Based self-learning module to stimulate HOTS.

| No | Assessment Component | Validator (%) | | | Average | Category |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | | |
| 1 | Content Quality | 90.00 | 91.43 | 94.29 | 93.13 | Very Worthy |
| 2 | Instructional Quality | 93.33 | 90.00 | 96.67 | 94.28 | Very Worthy |
| 3 | Media Quality | 96.92 | 95.38 | 93.85 | 96.25 | Very Worthy |
| | Average | | | | 94.55 | Very Worthy |

*b. Revision*

After validation is done, the draft is then revised based on suggestions and input from the validators. The results of the validation of the first draft and the suggestions given by each validator as well as the revision of phase I obtained from 3 experts, 1 chemist for the content of the material, 1 media expert and 1 expert, 1 chemistry teacher at MAN 3 Pekanbaru City and 1 peer review.

*c. Draft II*

After the draft I revised draft II which was revised based on input from the validators. The second draft was then tested for students of class XI MIPA 3 at MAN 3 Pekanbaru City.

*d. Field Test Results Data*

Data from learning activities in field trials consists of student learning trial data and critical thinking ability evaluation data.

*1) Limited Trial*

A limited trial was conducted on students of class XI MIPA 1 MAN 3 Pekanbaru City to see the legibility and to determine student responses to the STREAM-based self-study module to stimulate HOTS on petroleum materials. The results of the data obtained by filling out a response questionnaire. After the trial was limited to 15 students.

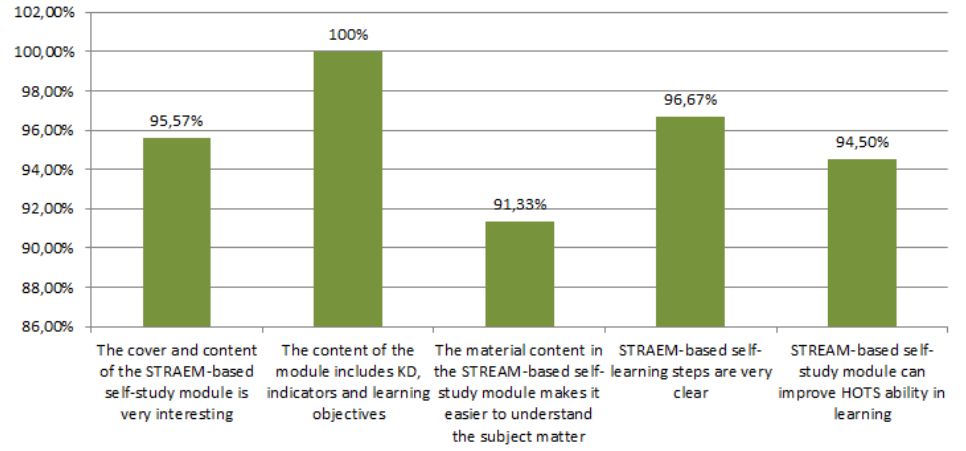


**Figure** 1: The results of the trial are limited to a small group.

*2) Large Scale Trial*

After the second revision, the module becomes the result of draft III. The draft module III was tested in a larger class, namely Class XI MIPA MAN 3 Pekanbaru City with 33 students. It aims to determine the improvement of HOTS ability and self-study ability. Tests in the class were carried out by first being given a product testing class pretest to determine the description of students' initial abilities on petroleum material before learning was carried out, and after learning was completed a posttest was carried out.

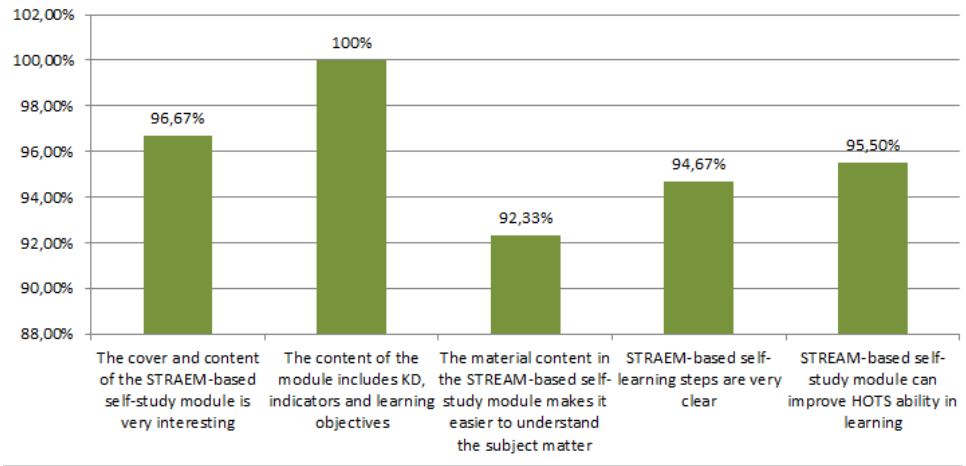


**Figure** 2: The results of trials in large groups.

*3) HOTS Ability Improvement Results*

Before the STREAM-based self-study module to stimulate HOTS was used in learning, the self-study ability instruments and HOTS for pretest and posttest were tested on students at MAN 3 Pekanbaru City. Before the module was distributed to 33 students in class XI, students were given a pretest to determine their initial ability to study independently and HOTS. STREAM-based self-study module to stimulate HOTS is given as a core module in the implementation of learning. After the material in the module is complete, students are given a posttest [15].

The analysis to determine the increase in critical thinking skills in learning uses a normalized gain score for the pretest and posttest of product testing classes. Based on the calculation of the gain score for the product testing class, including the medium category. The increase in self-study abilities and HOTS was assessed by the gain test from the results of the pretest and posttest obtained by students in large-scale trials. The results of the normalized gain score for the pretest and posttest values are included in the moderate category with a score of 0.55, so it can be said that the STREAM-based self-study module to stimulate HOTS on petroleum materials is effective [16].

To find out the initial abilities that students have, a pretest is carried out. Based on the test results, it is known that there is no significant difference in the experimental class and the control class. This means that the class selection comes from a homogeneous population. This situation is very helpful to see the learning outcomes of class XI students in learning Chemistry with STREAM-based self-study modules to stimulate HOTS on petroleum materials. Based on the research, there are differences in student learning outcomes between students who receive chemistry learning with STREAM-based self-study modules to stimulate HOTS on petroleum materials and students who receive petroleum chemistry lessons without modules.

Student learning outcomes in chemistry learning with STREAM-based self-study modules to stimulate HOTS on petroleum materials are better than students who get earth chemistry learning without modules for online self-study through google classroom. Students who get chemistry learning with STREAM-based self-study modules to stimulate HOTS on petroleum materials can better understand the concept of petroleum, because in the learning process students learn material with clear and systematic instructions equipped with interesting learning content through pictures and videos. explanation of the teacher's explanation of real life. This situation allows students to more easily understand knowledge and solve all the problems raised in learning.

*4) Disseminate*

The product distribution stage is a STREAM-based self-study module to stimulate HOTS on petroleum materials at the Chemical MGMP MA Pekanbaru City. The purpose

of this stage is to get a response to the module that has been developed. The results of the responses from several chemistry teachers are presented in table 2.

TABLE 2: Disseminate response results on STREAM-Based self-study modules to stimulate HOTS.

| Teacher | Grade | Category |
|---|---|---|
| 1 | 96.67% | Very Worthy |
| 2 | 94.67% | Very Worthy |
| 3 | 92.33% | Very Worthy |
| 4 | 94.67% | Very Worthy |
| 5 | 95.33% | Very Worthy |
| 6 | 91.50% | Very Worthy |
| average | 94.19% | Very Worthy |

The results of this study have been stated in the previous section describing that the application of STREAM-based self-study modules on petroleum materials can provide a better contribution to higher-order thinking skills. In the end, it is hoped that students will become more aware of the subject matter being studied, so that it has a positive impact on learning outcomes and mathematical communication skills. The advantage of this earth chemistry module is self-study and HOTS is a student-centered learning activity that helps students to see existing and newly accepted problems so that they are expected to gain a deeper and better understanding by understanding their own knowledge based on a clear and clear basis. Systematic learning instructions so that they can expand the discussion/knowledge, students can learn anytime and anywhere with a target time that has been determined by the teacher as the deadline for collecting assignments. Barriers in this research among other students takes a lot of time.

## 4. CONCLUSION

Students who get chemistry learning with STREAM-based self-study modules to stimulate HOTS in petroleum materials can better understand the concept of petroleum, because in the learning process students learn material with clear and systematic instructions equipped with interesting learning content through pictures and videos. STREAM learning strategies can make students active and creative and develop soft skills. Modules with the STREAM approach to chemistry learning, students can develop independent learning skills and higher thinking skills.

The test results based on the STREAM self-study module expert to stimulate HOTS on petroleum materials showed that the quality of the average score was 93.13% (very feasible category), the quality of learning had an average value of 94.28% (very feasible

category), and the quality of learning has an average score of 94.28% (very decent category), and technical quality (media) has an average value of 96.25% (very decent category). The results of the individual and group module readability tests were 95.65% and 95.83%, respectively (very feasible category). The feasibility test shows that the module developed is in the Very Eligible Criteria so that it can be applied to class XI Chemistry learning.

The use of STREAM-based modules on petroleum materials for self-study is very effective in increasing students' mastery of concepts in petroleum materials. Data analysis to determine the effectiveness of the learning model used, was carried out quantitatively. The effectiveness is known from the difference in post test scores between the experimental class and the control class, namely the average value of the experimental class is higher than the control class.

Based on the foregoing, the following is recommended:

1. Teachers use interesting teaching materials to improve students' conceptual understanding, one of which is by developing teaching materials in the form of STREAM-based self-study modules to stimulate HOTS in petroleum materials for independent study.

2. The modules developed should be used for independent study and can be accessed online and offline so that they are more efficient in all conditions.

3. It is necessary to develop module teaching materials for STREAM-based self-study to stimulate HOTS in other materials, so that the chemistry literature is teaching chemistry.

## ACKNOWLEDGMENTS

Acknowledges to the Chemistry Education Study Program of UIN Suska, students, teachers of MAN 3 Pekanbaru City, MGMP Kimia MA Pekanbaru City and all parties who have supported the implementation of this research.

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