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Development of E-Modules to Improve Students' High Order Thinking Skills

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Abstract. To face the 21st century, identification of student competencies that need to be developed is very important. When students are directed to be able to think critically, creatively and able to solve problems, it means that students are targeted to have higher order thinking skills (HOTS). This study aims to develop a general chemistry e-module for thermochemistry material to improve students' higher order thinking skills. The development model used refers to the ADDIE model. E-modules are prepared and developed by taking into account the material and media aspects and are designed to be HOTS-oriented using the Kvisof Flipbook Maker application. The developed e-module is declared feasible to be applied in thermochemistry learning based on the assessment of expert validators and has proven to be effective in increasing student HOTS based on student HOTS results.

INTRODUCTION

The development of modernization and globalization of the 21st century has had a tremendous impact. One of the worrisome impacts is the inability of children (students) independently to know, understand, and overcome problems around them. For the Indonesian people, another impact that is felt due to the challenges of modernization and globalization is the low thinking skills of students [1]. The results of the international PISA study show high reading literacy, mathematical literacy, and scientific literacy. achieved by Indonesian students is very low and can only occupy the bottom 10 of 65 countries [2].

To face the 21st century, identification of student competencies that need to be developed is very important. Students must hone skills and enhance learning to be able to overcome global challenges, such as critical thinking skills, the ability to communicate effectively, innovate and solve problems through negotiation and collaboration. When students are directed to be able to think critically, creatively and able to solve problems, it means that students are targeted to have higher order thinking skills (HOTS).

Low higher order thinking skills are not only experienced by students at the school level, but this also happens to students in college. The results of the initial study that the researchers did, it was found that there were still many new students whose higher-order thinking skills were still low, including in the General Chemistry course. The results of the researcher's analysis, most students still find it difficult to solve HOTS questions on indicators C4-C6. HOTS is a learning designed to prepare the 21st century generation. The 21st century generation must be prepared to have competencies and skills that include: critical thinking and problem solving competencies, creativity, communication skills, and the ability to work together [3].

High Order Thinking Skills (HOTS) measures the ability to: 1) transfer concepts, 2) process and apply information, 3) relate different kinds of information, 4) solve problems using information, and 5) examine ideas and information critically. HOTS is defined as the ability to use the mind to solve problems at hand. Therefore, one must understand, analyze, and interpret information. HOTS also teaches a person to be critical in evaluating information,

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draw conclusions and make generalizations. In the revised Bloom's Taxonomy, HOTS is a cognitive ability at the level of application, analysis, evaluation, and innovation [4].

Studying at university should be very different from studying in pre-university schools. Learning at the university does not only provide courses, topics, and strategic concepts, but is also expected to provide a learning experience that allows students' independent learning abilities to develop. Independent learning is learning with your own initiative, responsibility, and effort [5]. However, the main problem in learning in higher education is how to plan and prepare lecturers to manage learning in order to achieve the desired competencies in students [6]. Meanwhile, the problems of learning science (including physics, biology and chemistry) are related to three things, namely creativity, teaching materials/study materials and science process skills [7].

The most important element and the spearhead of HOTS learning change is the teacher or lecturer who wants to change the learning mindset that is applied. Learning that used to be dominated by monologue and lecture systems must be changed with a new pattern that activates the potential and abilities of students optimally by applying HOTS abilities. The application of HOTS abilities in the learning process makes students more resilient and able to solve their own problems [1].

Each individual's higher order thinking ability is certainly different, depending on the exercises that are often done to develop it. In addition to the use of learning strategies or models by teachers/lecturers, other factors that also determine the success of students in learning are teaching materials and media used by students as learning resources. Teaching materials that can be used by students as media and independent learning resources have an important role in improving and developing higher order thinking skills.

An educator, including lecturers, is also required to be able to design teaching materials and media that are oriented towards active student involvement and are expected to stimulate students to be able to think at higher levels. The development of teaching materials that are appropriate and in accordance with the learning needs of students is the best effort to be able to improve the achievement of students' academic achievements and foster students' higher-order thinking skills. To produce tools or teaching materials of good quality, teaching materials must be carefully prepared and planned to produce a good learning activity.

Teaching materials are not only in the form of books or worksheets based on print media. Non-print-based teaching materials can also be used in learning, for example in the form of electronic teaching materials. Along with the development of technology and information in the digital era of the 21st century, efforts to improve the quality of learning can be carried out through the use of technology in a system known as online learning. One form of online learning that can be applied by lecturers in learning is by utilizing media and teaching materials in the form of e-modules or can be called electronic modules.

E-Modul is a product of digital-based non-printed teaching materials that are independently designed to be learned by students. An E-Modul is an electronic version of a printed module that can be read on a computer and designed with the required software. E-module is a tool or learning tool that contains materials, methods, limitations and evaluation methods that are designed systematically and attractively to achieve the expected competencies according to the level of complexity electronically. E-module is a display of information in book format that is presented electronically using a hard disk, diskette, CD, or flash disk and can be read using a computer or electronic book reader [8]. E-modules are also called media for independent learning because they are equipped with instructions for self-study. It can be said that readers can carry out learning activities without the presence of the teacher directly [9]. E-modules can facilitate students in learning independently, because e-modules are equipped with instructions for independent study, so that students can learn according to their abilities.

E-modules are teaching materials or ICT-based modules, their advantages compared to print modules are that they are interactive, making it easier to navigate, allow displaying/loading of images, audio, video, and animation and are equipped with formative tests/quizzes that allow immediate automatic feedback. The use of web modules and media learning will ensure student control, flexibility, context free and also relatively conventional free.

The e-module that will be developed in this research is designed and compiled using the Kvisof Flipbook Maker software or application. Kvisoft Flipbook Maker is an application for creating e-books, e-modules, e-papers and e-magazines. Not only in the form of text, with this application you can insert images, graphics, sound, links and videos on the worksheet. In general, this multimedia device can include files in the form of pdf, images, videos and animations so that the flip book maker is made more attractive. In addition, flip book maker has design templates and features such as background, control buttons, navigation bar, hyperlinks and back sound. Students can read by feeling like reading a book physically because there is an animation effect where when switching pages it will look like physically opening a book. The final result can be saved to html, exe, zip, screen saver and app formats [10].

The developed e-module is also HOTS oriented. This is to answer the problems that researchers encountered while teaching lectures where students' high order thinking skills (HOTS) were still low. The use of HOTS-oriented

e-modules will lead students to think critically, creatively, looking for problem solving independently and this will provide a concrete experience in solving problems so as to grow and train students' higher-order thinking skills.

METHOD

This research belongs to the type of research and development (R&D), is a type of research that produces a product instead of testing a theory. The result of this research and development is a HOTS-oriented e-module in the General Chemistry subject for Thermochemistry to increase students' HOTS. The subjects in this research and development include: 1) validators of material experts and media experts (lecturers) to evaluate or assess the developed e-modules; 2) students of the Chemistry Education Study Program, FMIPA, Universitas Negeri Medan as many as 30 students. The object of this research and development is a HOTS-oriented e-module in the General Chemistry Course for Thermochemistry.

The development model used refers to the ADDIE development model. The procedure is carried out through several stages, including: (a) Analysis, namely conducting an analysis to collect information related to student needs and reviewing literature related to the product being developed; (b) Design, is the stage carried out to identify goals and design e-modules to be developed; (c) Development, is the stage to realize the design into a product that is ready to be implemented; (d) Implementation, namely implementing the product developed in the form of a HOTS-oriented e-module in the General Chemistry course for Thermochemistry; and (e) Evaluation, namely evaluating by analyzing the effectiveness of the use or application of e-modules on students' higher order thinking skills (HOTS).

The techniques and instruments used in this research and development include:

- Interviews are used for data collection when conducting research as a preliminary study material to look for problems to be studied and used in product trials both at the time of validation to experts and product trials in the field as a consideration in improving teaching materials developed;
- Validation sheet, used to obtain data about the results of the validation or assessment of practitioners and expert validators about the developed HOTS-oriented e-module. The validation sheet is given to the expert validator along with the HOTS-oriented e-module which will be evaluated or validated to obtain data, input, and expert validator suggestions. The results of the expert validator's assessment will be tested for feasibility or validity. The measurement scale on the validation sheet uses a scale of 5 (five);
- The test instrument, which is structured to obtain data on higher order thinking skills (HOTS) of students on thermochemistry material. The test is structured and developed according to the HOTS indicators including C4, C5 and C6 as many as 25 questions in the form of multiple choice with 5 (five) answer choices. In order for the tests that have been compiled to be of high quality, before being used as a data collection tool, it is necessary to analyze the items on the test instruments that have been prepared including the validity and reliability of the tests. The test is given to the test class students at the beginning of the meeting (pretest) before the material is taught and at the end of the meeting after the learning activities using the resulting e-module end (posttest).

The research data were analyzed in stages to determine and analyze the feasibility and effectiveness of the developed HOTS-oriented e-modules as well as the improvement of students' HOTS in the General Chemistry subject for Thermochemistry. The feasibility of the e-module can be analyzed from the results of the validation sheet filled out by the expert validator and from the results of questions and answers during the validation process to obtain advice and input from the expert validator. The validation results are used as guidelines for revising the developed e-modules. The validity (feasibility) of the developed e-module can be seen from the validation sheet filled out by the expert validator. The average score of the validation results is obtained from the total score of the validation results divided by the number of aspects and indicators that are assessed.

The effectiveness of the developed product is obtained from the achievement of the students' higher order thinking ability (HOTS) test results. The e-module effectiveness test was analyzed from the increase in students' HOTS using a pretest-posttest design pattern and in this design one sample group was taken without a control sample as a comparison. To find out the increase in student HOTS, it was analyzed based on the difference between the post-test scores and the pre-test scores obtained by the students. Before testing the hypothesis, the research data were first analyzed to determine the normality of the data using the Kolmogorov-Smirnov test technique. The effectiveness of the e-module was analyzed using a paired sample t-test approach with the help of the SPSS program.

RESULTS AND DISCUSSION

Results

The product developed in this study is an e-module oriented to HOTS General Chemistry Subject on Thermochemistry. Product development is carried out in accordance with the results of preliminary studies related to 21st century learning which requires students to have critical thinking and problem solving competencies, creativity, communication skills, and the ability to work together, as well as the results of preliminary analysis related to student HOTS in Chemistry. General Thermochemistry material, as well as student needs by reviewing literature related to the developed e-module.

The initial product development was in the form of a HOTS-oriented e-module device in the General Chemistry Course, Thermochemistry material which was compiled and developed using the Kvisof Flipbook Maker application so that students can read by feeling like reading a book physically because there is an animation effect where when switching pages it will look like opening a book. physically. The initial product developed is then evaluated or validated by expert validators to realize the design into a product that is ready to be implemented. Validation or feasibility of HOTS-based e-modules is evaluated by practitioners and expert validators in their fields (material experts and media experts).

TABLE 1. E-Module Validation Results on Material Aspects

Assessment Aspect	Validator (Mean Score)			Total Mean	Criteria
	I	II	III		
Eligibility of Content (Material)	3.83	4.33	4.17	4.11	Valid
Serving Eligibility	4.10	4.30	4.30	4.23	Valid
Language Eligibility	3.78	4.33	4.33	4.15	Valid
HOTS Rating	3.80	4.40	4.40	4.20	Valid
Mean Total Validation Results				4.16	Valid

Table 1 shows the results of the assessment and evaluation of the material expert validators on the e-module and obtained an average total score of 4.16 or declared valid. In the aspect of the feasibility of the content obtained an average score of 4.11 (valid); on the aspect of the feasibility of the presentation obtained an average score of 4.23 (valid); on the aspect of language feasibility obtained an average score of 4.15 (valid); and in the aspect of HOTS assessment obtained an average score of 4.20 (valid). Overall, the results of the expert validator's assessment on the material aspect concluded that the HOTS-oriented e-module Thermochemistry material developed was valid or feasible to be applied in learning.

TABLE 2. E-Module Validation Results on the Media Aspect

Assessment Aspect	Validator (Mean Score)			Total Mean	Criteria
	I	II	III		
Device Engineering	4.00	4.40	4.50	4.30	Valid
Interface Display	3.78	4.22	4.33	4.11	Valid
Visual Communication	3.63	4.25	4.25	4.04	Valid
E-Module Characteristics	3.80	4.60	4.40	4.27	Valid
Mean Total Validation Results				4.18	Valid

Table 2 shows the results of the evaluation and evaluation of media expert validators on the e-module and obtained an average total score of 4.18 or declared valid. In the aspect of device engineering, the average score is 4.30 (valid); on the aspect of the interface display obtained an average score of 4.11 (valid); on the aspect of visual communication obtained an average score of 4.04 (valid); and in the aspect of e-module characteristics obtained an average score of 4.27 (valid). Overall, the results of the expert validator's assessment on the media aspect concluded that the HOTS-oriented e-module Thermochemistry material developed was valid or feasible to be applied in learning.

After the HOTS-oriented e-module product developed is declared valid (appropriate) based on the validator's assessment of material experts and media experts, in the next stage the implementation or application of the developed product is carried out and continued by evaluating students after being given action or treatment using e-

modules. HOTS-oriented to analyze the effectiveness of the HOTS-oriented e-module that has been produced. The effectiveness of the HOTS-oriented e-module was analyzed based on student learning outcomes (HOTS) before and after using the resulting e-module. This stage was carried out to 30 students and carried out in 3 (three) stages including: (1) the initial stage, namely the provision of an initial HOTS test (pretest) through the Computer Based Test (CBT) application before students were given action using the resulting e-module, (2) the second stage, namely the learning process where students learn online by utilizing e-modules that can be accessed and downloaded using a laptop, computer or android device on the e-learning site of the Department of Chemistry Education, and (3) the third stage, namely giving the HOTS test end (posttest) via the CBT application.

TABLE 3. Student HOTS Test Results Achievements

	N	Min	Max	Mean	Std. Deviation	Kolmogorov-Smirnov Test	
						Statistic	Sig
Pretest	30	35	65	53.50	7.445	0.147	0.099
Posttest	30	65	100	84.67	7.871	0.151	0.079

Table 3 shows the achievement of students' initial HOTS test results (pretest) before being given the e-module, the lowest score was 35, the highest score was 65 with an average score of 53.50 and a standard deviation of 7.445 and the data had a normal distribution with Kolmogorov-Smirnov. test = 0.147 and p = 0.099. After taking action through learning using HOTS-oriented e-modules from the posttest results obtained the lowest score of 65, the highest score of 100 with an average student HOTS score of 84.67 and a standard deviation of 7.871 and the data has a normal distribution with the Kolmogorov-Smirnov test = 0.151 and $p = 0.079$.

The effectiveness of the application of HOTS-oriented e-modules in general chemistry learning of Thermochemistry material is analyzed from the increase in learning outcomes obtained by students in completing the HOTS test using pretest-posttest design and analyzed by t-test or paired sample t-test approach using SPSS program assistance.

TABLE 4. Product Effectiveness Test Results (Uji-t)

		Paired Differences		t	Df	Sig.
		Mean	*Std. Deviation*			
Pair 1	Posttest - Pretest	31.167	6.254	27.297	29	0.000

Table 4 shows the results of testing the effectiveness of the e-module using a t-test with a paired sample t-test approach and the t-count value is 27.297 with probability or sig. of 0.000 < 0.05 so it can be concluded that the implementation of the HOTS-oriented e-module produced in Thermochemistry learning has proven to be effective in increasing student HOTS with a difference or difference in the average student HOTS score (posttest-pretest) of 31.167 and a standard deviation of 6.254.

Discussion

The product developed in this research and development is in the form of an e-module for the General Chemistry course on Thermochemistry by taking into account the material and media aspects. The e-module is designed to be HOTS-oriented in accordance with the concept of 21st century education, one of which is learning and innovation skills, namely being able to think creatively, work creatively, and create new innovations. The HOTS-oriented e-module is designed using the Kvisof Flipbook Maker application so that students can read by feeling like reading a physical book because the e-module has an animation effect where when switching pages, it will look like physically opening a book, and is designed not only in the form of text, but also in the form of text. Also, by inserting images, sounds, links and videos on worksheets equipped with interesting animations, HOTS-based practice questions, and arranged based on indicators and learning outcomes for the General Chemistry course on Thermochemistry.

The initial HOTS-oriented e-module product that was developed was then evaluated by expert practitioners and validators to realize the design into a product that is ready to be implemented. The results of the assessment of practitioners and expert validators on the HOTS-oriented e-module in the General Chemistry Subject of Thermochemistry material that was developed as a whole have been declared valid and feasible to be applied in General Chemistry learning of Thermochemistry material. The validity (feasibility) of the HOTS-oriented e-module

was met qualitatively based on the assessment of the material expert validators (average score of 4.16) and media expert validators (average score of 4.18) which were overall stated in the valid category.

The implementation of HOTS-oriented e-modules in Thermochemistry learning has also proven effective in increasing students' HOTS. The effectiveness of the e-module was met statistically based on the increase in student achievement in completing the HOTS test carried out. Student responses to the resulting e-modules are also very positive, where students find it easier to understand and master the existing material or information, can help students learn independently by repeating the material anytime and anywhere because the module can be opened on the device. android. E-modules can also attract students' interest and motivation in independent study because they are designed and equipped with interesting animations, and can improve students' HOTS abilities because the materials and practice questions contained in the e-modules are designed to be HOTS-oriented which trains thinking skills. critical, creative, analytical ability to information and data as well as students' ability to solve problems.

The findings of this research and development have implications for lecturers that to improve students' HOTS abilities, it can be done by developing innovative teaching materials and one of them is HOTS-oriented e-modules. Utilization of this HOTS-oriented e-module, can help students improve their understanding, mastery and ability of HOTS. Through this HOTS-oriented e-module, students are trained to think critically, creatively, analytically towards existing information and data in solving problems. Therefore, lecturers are expected to be able to design and develop teaching materials in the form of e-modules that are able to create interactive lectures and can help students learn independently without compromising the essence of the lecture material delivered as well as helping to develop and improve students' HOTS abilities.

CONCLUSION

This research and development resulted in a product in the form of a HOTS-oriented e-module in the General Chemistry Subject of Thermochemistry. The HOTS-oriented e-module that was developed has also been declared valid (appropriate) based on the validator's assessment of material experts and media experts. The HOTS-oriented E-Module was developed through the ADDIE development model and has been declared valid (feasible) and proven effective in improving students' HOTS abilities. The validity (feasibility) is met qualitatively based on the assessment (validation) of the material expert and media expert validators which are overall stated in the valid category. The effectiveness is fulfilled based on the implementation of learning using e-modules and is proven from the results of statistical hypothesis testing with probability values <0.05 and evidenced by the increase in student HOTS learning outcomes with a difference or difference in the average posttest and pretest scores of 31.167 with a standard deviation of 6,254. Student responses to the resulting HOTS-oriented e-module are also positive.

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