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E-Module of Science Development Based on Higher Order Thinking Skills on the Material of the Human Circulatory System for VIII Grade Students

Kuntarti Suhartini[1*], Prasetyorini[1], Indriyani Rachman[1]

[1] Pendidikan IPA, Sekolah Pascasarjana, Universitas Pakuan, Bogor, Jawa Barat, Indonesia.

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Corresponding Author:
Kuntarti Suhartini
ksuhartini80@gmail.com

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Abstract: Skills in thinking to solve every problem in the form of higher order thinking skills (HOTS) are competencies that must be possessed by 21st century students. HOTS for Indonesian students based on the analysis of PISA results is still considered very lacking, One of the efforts to improve students' HOTS, teaching materials are made in the form of HOTS-based electronic modules. The aim of this research is to develop an e-module based on HOTS, as well as to determine the effectiveness of the e-module being developed. This study uses a development that refers to the 4-D technique initiated by Thiagarajan namely define, design, develop, and disseminate. This research involved 35 grade VIII students of SMPN 2 Dramaga, selected using a purposive sampling technique. Data collection was carried out through HOTS tests and questionnaires. Analysis of research data using paired t-test and N-Gain test. The results of the analysis show that after the use of HOTS-based e-modules there is an increase in HOTS with N-Gain of 62% in the medium category. Testing the effectiveness of the e-module using a paired t-test showed a result of 0.000 which means that the HOTS-based e-module has a significant effect on increasing student HOTS.

Keywords: Development research; E-module; HOTS; Science

Introduction

Education is the basic right of every human being which involves a process of observing knowledge on a prolonged basis (Dewey, 2004), and is the main factor for the formation of a generation of people who are ready to face the challenges of the 21st century in the era of globalization. Education is required to have the character to impart and provide skills to students in order to be able to follow the challenges of globalization in the present and in the future. These skills include higher order thinking skills (Copley, 2013), which will affect student achievement, thus increasing learning abilities and improving their performance while reducing their weaknesses (Heong et al., 2012), Higher Order Thinking Skills (HOTS) is a broad thinking process (Quellmalz, 1985), not only the ability to remember, but higher than that (King et al., 1998), so that students can do important and basic things such as describing material in the learning process, drawing conclusions, building connections and analyzing them (Resnick, 1987). HOTS in the revised Bloom's taxonomy is the cognitive ability to analyze (C4), evaluate (C5), and create (C6). HOTS can be implemented randomly in the learning process (Winarno et al., 2015), to measure student HOTS in Indonesia, one of the references is the results of PISA (Program for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study).

In TIMSS 2015, Indonesia was ranked 44th out of 49 countries. Meanwhile, the 2018 PISA results show that Indonesia is in 7th position from the bottom, far behind other Southeast Asian countries such as Malaysia and Thailand (Fenanlampir et al., 2019). This indicates that HOTS, one of which is reasoning skills (Damawati & Juanda, 2016) and students' scientific literacy abilities, is still not encouraging. The lack of students' reading ability is influenced by several factors, for example the

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condition of teaching materials. As summarized from research (Pratama & Sekitar, 2013) which states that the complexity of the teaching materials presented increasingly makes students weak and lazy in reading science teaching material sources.

In a preliminary study regarding the HOTS analysis of VIII grade students at SMPN 2 Dramaga which was carried out in the 2022/2023 academic year, the results obtained were less than expected. The students' scores on the HOTS indicator according to the revised Bloom taxonomy, the majority is as much as 75%, are in the very low category. From these problems, further efforts are needed to train and improve HOTS students in Indonesia, while increasing students' interest in reading, including by creating HOTS-oriented teaching materials (Marušić & Sliško, 2012), as an important aspect of life skills (BSNP, 2006). The results of a preliminary study at SMPN 2 Dramaga-Bogor by giving HOTS cognitive questions to students showed that students' ability to answer HOTS questions was still low, with the result that 75% of students' grades were still incomplete, only 25% were completed. It is hoped that students' difficulties in understanding the concept of the circulatory system can be helped through learning activities using simple experiments as well as image and video analysis outlined in the science e-module as part of HOTS-based learning.

Based on the needs analysis, data was obtained that 90% of students got low and very low scores in solving the HOTS questions given. Therefore, an alternative solution is needed to overcome this problem, by providing science teaching materials that can stimulate students' high-level thinking skills, one of which is by creating HOTS-based science learning e-modules. The science learning e-module based on higher order thinking skills (HOTS) is a science learning e-module that contains learning activities in accordance with the HOTS indicators of Bloom's revised taxonomy, namely the cognitive domains of analyzing (C4), evaluating (C5) and creating (C6) (Anderson & Krathwohl, 2001). What is new in this research is the preparation of the e-module using an inquiry approach (Gay et al., 2006), so that it is hoped that students can use the module coherently independently, as if experiencing learning in class. The process of compiling e-modules is made using an inquiry approach, which prioritizes the learning process by conducting your own research (Reinmann, 2019). The e-module is also equipped with interactive quizzes in the form of quizzes, videos and links to easy learning resources, as well as experimental steps that are easy to do and contextual, suitable for junior high school students, so it is hoped that it will further stimulate students' HOTS. Based on some of the problems previously stated, a study was carried out with the title "Development of E-Module Science Based on Higher Order Thinking Skills on the material of the human circulatory system for Grade VIII Middle School Students". Based on the description of the research background, the formulation of the problem that will be studied in this study is how to develop a Science e-module based on Higher Order Thinking Skills on the material of the human circulatory system for class VIII junior high school students, can be done and seen based on characteristics, application implementation, and the practicality of the e-module to increase student HOTS.

Method

The method used in this research is Research and Development (R&D), which is a research process that examines consumer needs and then develops products to meet these needs. The research procedure was carried out by applying the 4-D model, a learning tool development model developed by (Thiagarajan, 1974). This model includes 4 stages, namely define, design, develop, and disseminate, abbreviated as 4D. This development model is also often known as the 4-P model, namely defining, designing, developing and disseminating (Hobri, 2010).

The innovative teaching material that will be developed is a HOTS-based science e-module on the human circulatory system. Product effectiveness was measured by pre-experiment involving one experimental class. The research subjects were 35 grade VIII students of junior high school, who were taken using a purposive sampling technique at one of the schools in Bogor Regency (Fraenkel et al., 2016). The research instruments used in this research include validation sheets, student response questionnaire sheets, and HOTS question instruments. This quantitative research uses a pre-experimental design with a one group pretest-posttest design. The effect that occurs due to treatment is determined based on the difference between pretest and posttest, with a paired t-test. The steps for developing HOTS-based e-modules using the 4-D development model in this research can be described as follows:

Define

At this stage, efforts are made to determine and define development requirements, to reveal the characteristics of the e-module to be developed. Identification of problems and necessary needs. The first thing to do is an analysis of the curriculum that applies in the school. The initial activity of this stage is defining the needs of students and teachers, by distributing needs analysis questionnaires to students and teachers. The results of the questionnaire are used to determine the

needs of students and teachers which are then used as the basis for developing e-modules. Apart from that, an analysis of the HOTS possessed by students was also carried out, as well as material analysis to find out more specifically students' abilities and material with low absorption capacity, so the author felt it necessary that this material be studied using HOTS-based e-modules. The material chosen in this research is the human circulatory system, with the theme delivered in the e-module adapted to the characteristics of junior high school students. The next activity is to conduct a literature study related to the e-module and the chosen approach (Suhartini et al., 2023).

Design

This stage is to design a HOTS-based science learning e-module format containing the theme of the human circulatory system, which will produce an initial draft as an e-module prototype with the following stages:

a) Format selection

The choice of format is adjusted to the e-module criteria adapted from the format (Pusat Kurikulum Depdiknas, 2011) which includes three main parts, namely introduction, content and conclusion. Introduction, consisting of title, foreword, and theme integration map containing KI and KD as well as material details, concept map, introduction to the module which contains the background to the development of the module. Also instructions for using the e-module, description of the e-module display, and table of contents, list of figures, and list of tables. Contents consisting of learning sub-themes containing images and brief descriptions of the learning themes discussed, learning activities contains learning materials and activities that are packaged according to the stages of learning with an inquiry approach. Learning activities (KB) begin with a display of images representing the material discussed in the KB along with learning indicators that must be achieved by students. This e-module is divided into three KB, with each KB consisting of: (1) "Tahukah kamu?", containing pictures, videos or articles to foster students' curiosity, (2) Answering preliminary questions, containing a column for writing answers, (3) “Ayo Kita Lakukan!”, contains simple experimental activities, (4) “Coba Pikirkan!”, contains questions for students to stimulate reasoning and analysis. Content also consisting description of the material, independent assignments and formative Test. Conclusion contains a summary, answer key and assessment method, glossary.

b) Learning design in e-module

Based on the results of the preliminary study at the definition stage, learning planning can be carried out as follow the basic competencies selected to be developed in the e-module are KD 3.7 and KD 4.7, learning is developed based on the 2013 Curriculum. E-modules developed based on HOTS, so that learning design pays attention to the cognitive domains of analyzing (C4), evaluating (C5), and creating (C6). The developed module consists of 3 learning activities (KB), namely KB 1 about the structure and function of the circulatory system, KB 2 about the mechanism of blood circulation, KB 3 about disorders and efforts to prevent and overcome them. Each KB contains learning stages (a) Did you know, (b) answering preliminary questions, (c) Let's do it (d) Think About It. The chosen approach is the guided inquiry based learning approach. The natural science theme raised in this module is the human circulatory system. Students will immediately learn about one of the systems in their body contextually.

c) E-module design stage

Collecting materials used in making the e-module, with the final result being a draft I of the e-module, which is then validated and tested in the next stage.

Develop

This stage is to determine the feasibility of the e-module, as well as the magnitude of the increase in HOTS students after using the e-module. The first step is validate initial draft, validation was carried out on material, language, e-module graphics, as well as peer reviewers, each of which was carried out by material experts, linguists, learning media experts, and colleagues. The next step is revision, to revise the initial draft. This revision produces a draft e-module that is ready to be tested on a limited scale. The final step in *develop* stage is trial in class which conducted on VIII grade students to determine readability, criticism and suggestions from students as e-module users, as well as to find out the results of implementing the e-module. Suggestions from students as well as test results in limited trials are used as a basis for carrying out revision II, to obtain a better module.

Disseminate

At this stage further research is needed because it requires a longer time.

Result and Discussion

This research produced a product in the form of teaching materials in the form of an e-module in the form of a flipbook, based on Higher Order Thinking

Skills (HOTS) on the material of the human circulatory system for class VIII students of junior high school. The development of this e-module follows the 4-D (four -D model) stages initiated by Thiaragajan et al. which includes four development stages, namely define, design, develop and disseminate. This study carried out 3 stages, namely design, define and develop, while the disseminate stage requires a longer time, so further research is needed.

Research on the development of HOTS-based e-module teaching materials was carried out as a follow-up to the preliminary research conducted, in the form of a HOTS analysis of class VIII students on the subject of the human circulatory system. The results of the preliminary research conducted showed that the HOTS of class VIII students in this material were mostly in the very low category. So that further research is carried out on how and what efforts can be made to improve students' higher-order thinking skills. In addition, an analysis of the needs of adequate teaching materials was also carried out to increase student HOTS which stated that no HOTS-based electronic module had ever been used and studied by students.

It is hoped that the development carried out can increase student competence in terms of thinking skills at a higher level. In addition, teachers can be helped in terms of delivering material with electronic teaching materials in the form of e-modules that students can access anywhere, and learning can be carried out independently so that it makes it easier for students to understand a concept. The following are the results of the research and discussion of each development stage carried out:

Define

In the context of e-module development, the define stage is carried out by conducting a literature study, field observations, preliminary studies in the form of HOTS analysis and material analysis. A literature study is carried out by conducting a study of the curriculum used, and it is carried out to determine the competencies that will be integrated into the e-modules that will be developed. The literature study also studied concepts related to higher order thinking skills or Higher Order Thinking Skills (HOTS) for students and various strategies in the learning process that can be implemented so that student achievement can increase. Field observations were carried out on VIII grade students of SMPN 2 Dramaga - Bogor Regency, with the following results: 1) The school library is quite comfortable and equipped with various types of subject books that support the learning process, 2) books in the library are books obtained from publishers , not the result of the development carried out by the teacher, 3) the books available in the library based on Higher Order Thinking Skills (HOTS) are still not too many, only books from the Ministry of Education and Culture, 4) The Science Laboratory has complete equipment, but does not have a laboratory room that can used for practicums because most of them are used as temporary classrooms.

Researchers conducted a preliminary study in the form of HOTS analysis of VIII grade students at SMPN 2 Dramaga for the 2022/2023 academic year on material about the human circulatory system. This preliminary study uses a HOTS question instrument in the form of multiple choice questions with 15 questions. Students at SMPN 2 Dramaga in terms of age range from 11-15 years, which is the age of the transition stage, a transition from the concrete operational level of thinking to the abstract thinking stage, and looking at the world as a whole or holistic (Pusat Kurikulum Depdiknas, 2011). Students at SMPN 2 Dramaga generally get lower scores for science subjects on the National Examination. The results of the analysis of students' higher order thinking skills carried out in the preliminary study showed less encouraging results. The material chosen for this e-module is the class VIII human circulatory system, which is KD 3.7 and 4.7 in the 2013 curriculum which is still used by class VIII students at SMPN 2 Dramaga. Researchers analyzed the learning approach that will be used in preparing the e-module. Learning competencies are formulated when creating e-modules to create learning indicators that are based on existing competency standards and basic competencies. The next stage is to compile the material in an e-module that is adapted to the HOTS principles which are realized using a guided inquiry approach. Some of the tools used in compiling e-modules in this research include laptop, is used in the process of compiling e-modules; camera on smartphone, used when taking pictures directly; quiziz application, which is used to create questions interactively on e-modules. The other tools is flipbook application, which is used as an e-module opening application; and canva application, as an e-module maker application.

Design

The results of the preliminary study conducted at the define stage, made an initial draft of the HOTS-based e-module which included e-module design stage and initial draft e-module creation stage. The e-module is designed based on a needs analysis, the curriculum to be used, the syllabus, the material for which the e-module will be made, the purpose of preparing the e-module and the applications that will be used in using this e-module. These points are then included in the preparation of the RPP and the question grid which will

be used as the initial reference in making the HOTS-based IPA e-module. The first result is the initial draft of the e-module to be developed. RPP and the problem grid are made with reference to the Higher Order Thinking Skills (HOTS) indicator of the revised Bloom's Taxonomy, which includes the cognitive domains of analyzing (C4), evaluating (C5) and creating (C6), with the Inquiry based learning model. The created e-module contains all stages of learning that are poured into Learning Activities (KB) included in the e-module. The HOTS-based science e-module on the human circulatory system material is arranged in three learning activities. Learning activity 1 contains material on the structure and function of the circulatory system, learning activity 2 includes material on blood flow and heart rate, and learning activity 3 contains disorders of the circulatory system and how to overcome them.

Initial draft e-module creation stage is creating an initial draft of this e-module includes the cover page, preface, the description of the materials, the opening facts, and the additional questions, trial or experiments, discussion and data interpretation activities. Apart from that also included student reflect, assignment, formative test, response assessment, final test e-module, and attachment. The cover page contains the title of the e-module, the learning approach used, class, author, and a description of the completeness of the module. The cover depicts a human chest in which there are organs of the heart and blood vessels, and animated images of blood.

Preface, table of contents, list of figures, list of tables, concept maps, introduction. In the introductory section, there is a brief description of the e-module, core competencies and basic competencies, learning instructions, as well as the role of parents and teachers. The description of the material is contained in Learning Activities (KB). In this e-module, 3 learning activities are made, which consist of 3 sub-materials. Learning activities begin with learning indicators, which are followed by learning activities in which there are descriptions of material, assignments, and formative tests. Additional material descriptions are inserted in the form of links to Google Drive which can be accessed using QR codes and links, which will further broaden students' insights in terms of deepening understanding of the material.

The opening facts are accompanied by trigger questions provided in the rubric 'did you know?'. Questions about daily events or are contextual in nature, which are related to the context of the material to be discussed in the learning activities in the e-module. This is intended to stimulate students' curiosity to study the material in the e-module in more depth. Apart from that, it is to build students' thinking skills at a higher level. Additional questions that provide opportunities for students to answer questions or put forward hypotheses according to each student's experience. Presented colorful pictures and interesting videos related to the circulatory system material to further increase students' understanding and increase the attractiveness of the e-module. In addition, additional constructive questions are provided on the sidelines of the description of the material in the e-module which students can directly fill in, to further hone their thinking skills with contextual questions and those related to the material they have just read.

Trials or experiments, which are presented in the rubric 'Let's do it', are activities that students can carry out in the form of experiments carried out independently by students using inquiry to get answers to problems that arise from trigger questions that direct students to look for solutions. Discussion and data interpretation activities, which are provided in the 'let's discuss' rubric, which provides students with the opportunity to collect information from the results of experimental activities, and discuss it with other students in terms of data interpretation. Students can communicate the results of the group discussion in the form of a presentation or performance. Students reflect or provide feedback on the learning process that has been carried out in the 'reflection' rubric, by answering several questions that summarize students' knowledge during the learning process or feelings during the learning process.

Assignments, in each Learning Activity, contain questions that students can work on independently, to further hone students' high-level thinking skills. Formative tests are included in every learning activity, with questions presented interactively using Quiziz, with scores that can be checked directly in the answer key section of the e-module. This formative test is equipped with instructions for evaluating the results of the formative test. The question instrument was created based on Higher order thinking skills using cognitive dimensions at levels C4 (analyzing), C5 (evaluating) and C6 (creating). Response assessment, which contains guidelines for assessing tests in the e-module, to determine achievement in mastering the material.

Final Test of the Module, is a test that is carried out after completing the 3 learning activities in the e-module. The final module test is in the form of interactive multiple choice in Quiziz, which can also be accessed using a QR code. Attachments in which there is a glossary, answer keys for assignments and formative tests for each learning activity, answer keys for the final module test, and bibliography. The specifications for e-modules like the explanation above have a goal for the process of building high-level thinking skills in students,

namely in the form of the ability to analyze (C4), evaluate (C5), and create (C6). The expected final result is increasing student learning achievement.

Develop

The development stage is carried out by starting with a validation test of the HOTS question instrument by an expert validator who is competent in his field, a Biology lecturer with a Doctoral qualification. The first step is validation of teaching materials by material and media validators. The e-module design validation uses an instrument in the form of a validation sheet, in which the implementation of the validation process is made by two media experts with Masters (S2) and Doctoral (S3) educational qualifications. Material validation in this e-module is carried out by Biology lecturers with Doctoral qualifications, to find out the shortcomings and advantages of teaching materials made in terms of material or content, which will then be based on input from the validator various improvements will be made. Suggestions from the media validator include using questions in the form of stories, and avoiding just points, with the aim of stimulating students' HOTS more. Furthermore, for certain images and materials takenfrom various sources, it is mandatory to state the source. The results of dat Suggestions and input from students were used as the basis for further revisions to the HOTS-based e-module being developed. After the trial activities in class, the HOTS-based human circulatory system e-module was produced for class VIII students. The last step is learning outcomes data from the learning process is in the form of cognitive assessment at the level of analyzing (C4), evaluating (C5), and creating (C6). Analysis from the material validator are presented in table 1.

Table 1. Validation Results of E-Module Material by Validators

Aspect	Average Value	Percentage (%)	Criteria
Curriculum Eligibility	4.5	90	Excellent
Content Eligibility	4.4	88	Excellent
Feasibility of learning strategies	4.5	90	Excellent
Language Eligibility	4.8	95	Excellent
Average	4.6	91	Excellent

The quality of the human circulatory system e-module based on higher order thinking skills, in terms of material, has a curriculum suitability of 90%, content suitability 88%, learning strategy suitability 90%, language suitability 95%. This shows that the HOTS-based e-module is very feasible to use.

Input from the media expert validator includes a more attractive cover appearance in terms of images, layout and color selection. In addition, the type and spacing of letters, margins, and other writing procedures must be considered according to junior high school students. Then the video must be changed without using a link, but students can directly click on the video, and the formative test must be changed to use an interactive test, namely Quiziz. The validation results from the analysis of material validation and media validation can be seen in table 2.

Table 2. Results of E-module Media Validation by Validators

Aspect	Average Value	Percentage (%)	Criteria
Design Feasibility	4.8	96	Excellent
Eligibility to Use the application	4.7	95	Excellent
Language Eligibility	4.7	93	Excellent
Average	4.73	95	Excellent

Suggestions and input from colleagues include that overall the e-module can be used, you only need to choose the language used that is suitable for junior high school students, the size of the letters is not too small, and the media background does not need to use lines like in notebooks. , so as not to seem crowded. Conclusions from media expert validators, regarding the assessment of the e-module's design feasibility of 96%, application usability of 95%, and language suitability of 93%, are included in the very good category. The description of the material regarding the human circulatory system is in accordance with the KI/KD. Recommendations regarding the feasibility of the e-module are that it is suitable for use with improvements.

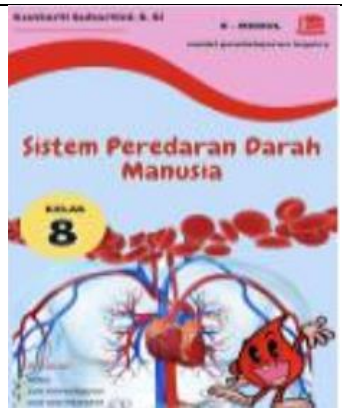
Suggestions and input obtained from validators are used for revision material. After carrying out the revision process, the results of this validation produce a draft e-module which will proceed to the next stage, trial in class. Testing the wider use of e-modules in limited groups conducted in sample classes, class VIII SMPN 2 Dramaga, starting July 5 2023, with the use of revised e-modules based on input from expert validators or Expert Judgments in the field media. Some improvements based on input from the media validator for HOTS-based e-modules are shown in table 3.

Trials in class were carried out starting with giving a pretest, to find out an overview of students' initial abilities in the human circulatory system material, before entering the learning process using the developed e-module. The pretest questions given are HOTS-based questions that have been validated by expert validators with Doctoral education qualifications (S3). In this trial, the science learning process in class used e-modules from the results of the development carried out and the teacher acted as a facilitator and companion in the

learning process in class. Students learn actively, following the flow in the e-module. Students use the e-module using their respective cellphones, and study and complete the module individually or in groups, according to what is directed in the e-module. HOTS dimension components are not steps that must be carried out sequentially or with clear syntax. The learning process by analyzing, evaluating and creating is the HOTS domain which can be carried out randomly in learning activities.

Students answer the problems posed in the e-module by finding the answers themselves. The process of searching for answers or solutions to the problems presented is carried out using scientific inquiry, by searching, analyzing the contents of the e-module or through experiments whose stages have been presented in the e-module. The experimental stages are equipped with follow-up questions that stimulate students' thinking skills. In answering various existing problems, students can sort out various information that is relevant to the problem. The experimental stage process presented in the e-module will also make students actively carry out scientific inquiry activities to get answers to problems. The process of sorting and analyzing relevant information, as well as the inquiry process in finding answers to problems is one of the characteristics of higher order thinking skills (HOTS).

Table 3. Revision of the E-Module based on Validator Input

Revised items	Before Revised	After Revised
Cover e-module improvements to colors, images and titles		
List of contents improvements to background and content		

Revised items	Before Revised	After Revised
Improvements to tables and addition of learning resource links		
Improved video formats		
Font fixes, margins, and formative tests made interactive in the form of quizzes		

Students who have studied e-module or carried out experiments in the e-module will then be given the opportunity to take the formative tests provided in the e-module. Activities that students can do to train students' higher level thinking skills cannot only be done at school. The e-module contains activities that students can do independently at home. The "Ayo Kita Lakukan!" activity is an independent experimental activity to stimulate students' activity and creativity to carry out an inquiry process to solve a problem, the results of which can be communicated in the form of a presentation in front of the class. This series of learning activities will train and grow students' high-level thinking skills, namely the skills of analyzing, evaluating and creating which are the HOTS domain.

Suggestions and input from students were used as the basis for further revisions to the HOTS-based e-module being developed. After the trial activities in class, the HOTS-based human circulatory system e-module was produced for class VIII students.

Disseminate

The disseminate stage was not carried out in this study, due to limited research time, which made it impossible to carry out the dissemination stage.

Students' higher order thinking skills using HOTS-based e-module

Teaching materials in the form of HOTS-based e-modules which were developed after undergoing a validation process will be tested on a limited basis in class to determine their effectiveness. A limited test was carried out in class on 35 class VIII students, in the science learning process which studied material on the Human Circulatory System, using a HOTS-based e-module. The effectiveness of teaching materials refers to the results of the pretest and posttest that students do.

Table 4. Student Higher Order Thinking Skills Test Results

Description	Pre-test	Post Test
Number of Students	35	35
Lowest Score	25	50
Highest Rating	70	100
Standard deviation	46.1	79.1
Average Score	11.704	14.628
N-Gain Score	0.62 (Medium Category)	

The pretest and posttest question instruments are 30 multiple choice questions, which have undergone a validation process, and use a cognitive dimensional approach at the levels of analyzing (C4), evaluating (C5) and creating (C6), in accordance with the revised Bloom's Taxonomy. The N-gain value for students' high-level thinking skills was generally 0.62 (medium category), with the average score increasing from 46.1 to 79.1. Complete data can be seen in table 4.

Table 4 shows an increase in student scores by looking at the pretest and posttest comparisons, after learning using the HOTS-based e-module. The N-gain results show that the use of HOTS-based e-modules has a significant impact on increasing students' higher-order thinking skills. The significance level of the pretest and posttest values in this study can be determined by conducting an inferential test, using SPSS. The test results can be seen in table 5.

Table 5. Results of Inferential Analysis Using SPSS

Item	Number of Students	Normality Test		Hypothesis test	
		Value	Description	Value	Description
Pre Test	35	0.134	Normal	0.000	Significant
Post Test	35	0.092	Normal		

Proving the significance of the HOTS-based e-module on students' higher-order thinking skills begins with a prerequisite test in the form of a normality test which is a descriptive statistical test. The test was carried out in the form of a normality test with the Shapiro-Wilk test, which is used to test the normality of data on samples with less than 100. The Sig value obtained for the pretest was 0.134 and the posttest was 0.092, using SPSS version 26. According to the data in table 4, the pretest and posttest significance values were greater than 0.05 which indicated that the data had a normal distribution. The N-gain results show that the use of HOTS-based e-modules has a significant impact on increasing students' higher-order thinking skills. The N-gain value for each HOTS indicator can be seen in table 6.

Table 6. Student HOTS Indicator N-gain Value

Indicator	The average value of the Pretest	The average value of the Posttest	N-gain
Analyzing (C4)	6.3	9.1	0.714
Evaluating (C5)	4	8	0.6107
Creating (C6)	1.2	3	0.483

Table 6 shows that the HOTS percentage value of students with the analyzing level cognitive domain indicator (C4), has a higher value than the evaluating level indicator (C5) and the creating level indicator (C6). This is in sync with research (Wahyudi et al., 2022), which found that the analyzing level HOTS indicator (C4) had the largest percentage and the creating level HOTS indicator (C6) had a smaller percentage value. On the other hand, research conducted by Wahdah et al., (2019) also shows that the HOTS analyzing indicator (C4) has the largest percentage and the creating indicator has the smallest percentage. Students remain in the deficient category when classified. One of the indicators of the learning process used is analyzing blood components and their functions, as well as analyzing blood circulation mechanisms in the human body.

The evaluation indicator is between the largest percentage value (analyzing indicator) and the smallest percentage value (creating indicator). This is in line with a study conducted by Wahdah et al. (2019), which found that the evaluating indicator (C5) was in the middle, between the percentage with the largest value, namely the analyzing indicator (C4) and the percentage with the smallest value on the creating indicator (C6). On the other hand, in research conducted by Datoh et al. (2019), the evaluating indicator (C5) was between the percentage with the largest value on the analyzing indicator (C4) and the percentage with the smallest value on the creating indicator (C6). However, in the overall categorization it is in the very less category. Learning indicators used include evaluating the blood grouping mechanism and concluding a case related to the human circulatory system, with KKO evaluating and concluding.

The HOTS indicator at the cognitive level of creation (C6) has the lowest percentage compared to the indicators at the level of analyzing (C4) and evaluating (C5). So that the C6 level is included in the very low

category. This is in line with research conducted by Gais et al. (2017), the percentage of creating is below the percentage of analysis and evaluation percentage. This is due to the fact that students face problems in solving verbal problems, understanding concepts, and applying principles. This is in line with a study conducted by Kamila et al. (2020), which found that students were less successful in the aspects of creating compared to the aspects of analyzing and evaluating, because students continued to experience problems at the creative level (C6). One indicator of the learning process used is that students can design a blood group experiment, by knowing the mechanism that occurs in blood grouping and the general mechanism in the human circulatory system.

Table 6 shows that the average scores obtained by students for all HOTS indicators are in the very poor category. Some students' HOTS components are considered low, as shown by interviews with science teachers at the school. The test is in the form of multiple choice instrument questions with cognitive level indicators C1 (remembering), C2 (understanding), C3 (applying), and C4 (analyzing). However, the teacher saw that students' characteristics in working on test questions only used cognitive levels C1, C2, C3, and C4. This is in accordance with the opinion of Kusuma et al. (2018) that, although there are a few questions available to train students' higher-order thinking skills, most of the problem instruments used by schools in Indonesia for cognitive level assessment tend to be aimed at testing aspects of memory or remembering. Teachers do not often use questions that train skills in thinking at a higher level, such as problem solving, reasoning, investigation, and open-ended questions (Abral et al., 2018). According to Maharani et al. (2020) the question instruments used do not help students in practicing HOTS.

As stated by Abdullah et al. (2015), many errors in exam completion are caused by students' processing skills and poor understanding of the questions asked. This is in line with the statement made by Gais et al. (2017) that the reason students still make mistakes in solving HOTS questions is because they do not understand what is being asked and do not pay enough attention when answering questions. However, Hajar et al. (2018) stated that, because each student has a different level of understanding, each student has different HOTS abilities. According to Yuliati et al. (2018), the classroom environment, psychological characteristics and students' intellectual abilities are three factors that influence students' HOTS.

The class VIII students of SMPN 2 Dramaga who were involved in this research used the 2013 curriculum, even though class VII had started using the independent curriculum. The 2013 curriculum used by class VII has proven to be able to improve HOTS questions. This is in line with the opinion of Ichsan et al. (2019) that the use of the 2013 curriculum can increase students' HOTS because learning is not only focused on the teacher, but also students participate in the learning process, which stimulates students' HOTS. In an effort to increase students' HOTS, several studies have been conducted, including the application of learning strategies to increase thinking skills (SPPKB) which are effective for increasing HOTS in mathematics learning (Puspa et al., 2020). The inquiry approach can also increase students' HOTS in STEM learning (Madhuri et al., 2012). A two-level multiple choice assessment tool can be used to evaluate excellent thinking skills (Van Hayus et al., 2014). Quantum learning methods produce higher intelligence that is better than direct learning models (Haryanti & Saputro, 2016). A study shows that teachers can improve students' HOTS by using strategies, approaches, models, and tools used in learning.

Conclusion

The development of teaching materials in the form of science e-modules based on Higher Order Thinking Skills (HOTS) on the human circulatory system is an innovation that is proven to be able to improve students' high-level thinking skills. The HOTS-based science e-module contains qualities that meet the requirements of a teaching material such as suitability of design, suitability of content, suitability of application use, and suitability of language, suitability of presentation, suitability of content, and suitability of learning strategies. The e-module was prepared and developed based on the competency demands that students must have to face 21st century globalization, including thinking skills at a higher level. HOTS-based e-modules are effective in improving students' high-level thinking skills with an N-Gain score of 0.62 in the medium category. Based on the analysis of research data obtained, HOTS-based science e-modules can increase understanding and interest in the material during the learning process.

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Author Contribution
investigation, K. S; formal analysis, K. S; investigation, K. S; resources, P, I. R and K. S; data curation, P and K. S: writing e-module HOTS based original draft preparation, K. S; writing e-module HOTS based review and editing, P, I. R and K. S: visualization, K. S; supervision, P, and I. R; project administration, P and K. S; funding acquisition, P and K. S. All authors have read and agreed to the published version of the manuscript.

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