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21st Century Learning Innovation: Analysis of the Development Needs of Hots-Oriented Modules in Biology Materials

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ABSTRACT

Improving the quality of learning requires the availability of instructional materials that not only deliver information but also foster students' Higher Order Thinking Skills (HOTS). This urgency has prompted an analysis of the development of instructional modules oriented toward HOTS. This study focuses on analyzing the needs of teaching materials in the form of Higher HOTS-oriented modules for high school/MA students in class X as a means of the learning process. The purpose of this study was to determine the needs of students for the module teaching materials to be developed. The method used is descriptive qualitative method. The research instrument used was a questionnaire and a checklist. The data collection technique used was the observation of lesson plans and modules used by the teacher, as well as a survey of the needs of students and teachers. The data analysis used is by reducing the data into more specific data to be presented descriptively. The results obtained are that 93,3% students need teaching materials in the form of modules that can train higher-order thinking skills. Based on this, it is necessary to develop a HOTS-oriented module on biology material for the even semester of class X High School which can support the biology learning process in schools.

INTRODUCTION

Education in the 21st century is challenged to shape change and improve human resources. In line with this, Kumalasani and Kusumaningtyas (2022) stated that it is necessary to improve quality, feasibility, and competitiveness through education. Education must be able to adapt and be dynamic so that it can keep up with the changes that occur. This brings demands for education providers to have a wise and solutive attitude so as to support the realization of the implementation of education in the 21st century. According to Rosidah (2020), one of the support systems that determines the success of 21st century learning is the curriculum.

The Independent Curriculum is part of the Ministry of Education and Culture's efforts to meet the needs of students that are adapted according to the context and characteristics of students in order to build competencies that are in accordance with current and future needs. The curriculum is aligned with education in the 21st century which is challenged to produce resources that have basic abilities known as the 4Cs (Critical Thinking and Problem Solving, Collaboration, Communication, Creativity) (Adnan et al., 2021; Synagogue, 2020; Kumalasani & Kusumaningtyas, 2022). Eng (2017) explained that recently two new basic abilities have emerged, namely the 2C (Citizenship, Character). The addition of the 2Cs is because a student must know their respective roles as citizens and have the character/virtue needed at this time. Therefore, the term 6Cs (Critical Thinking, Collaboration, Communication, Creativity, Citizenship, Character) emerged which is expected to be able to keep up with the demands of the global world in the future. The six parts are part of the Higher Order Thinking Skills (HOTS).

The Australian Council for Educational (ACER) in Ariyana, et al. (2018) states that the ability to think at a higher level is the process of analyzing, reflecting, giving arguments (reasons), applying concepts to different situations, arranging and creating. Through HOTS, students will distinguish ideas or ideas clearly, critically, creatively, argue well, be able to solve problems, be able to construct explanations, be able to hypothesize and understand complex things more clearly, where this ability clearly shows how students reason. In line with this, learning in the 2013 curriculum requires students to have high-level thinking skills (Noviani & Wijaya, 2020; Yayuk et al., 2019; Septikasari and Rendy, 2018; Setiawati et al., 2018).

However, the problem that arises in the world of education is that students are not able to use knowledge consistently to provide explanations, evaluations, and interpretation of data in complex situations that require cognitive thinking at a high level. Research conducted by Saraswati & Agustika (2020) shows that students in general are only able to complete test items at a low cognitive level and still have low ability to solve C6 cognitive problems. In line with this, the results of research by Adnan et al., 2021 in Makassar City; Syam and Efwinda, 2018 in Samarinda City also concluded that students' high-level thinking skills are still in the low to sufficient category. This shows that it takes awareness from students themselves to improve their thinking skills accompanied by encouragement and facilities from educators.

Educators must be able to create a learning atmosphere that makes students active, including providing teaching materials that are relevant to the needs of students and supporting the learning process. This is in line with the opinion of Nurhikmayati & Jatisunda (2019) that the teaching materials used must be in accordance with the characteristics of the target. The teaching materials used should be able to guide students to achieve the desired learning goals. Modules are one of the teaching materials that are able to support learning in the classroom. According to Nurhayati, et al. (2019) and Umami, at al. (2024) the module is a tool for organizing subject matter that pays attention to the function of education. The strategy of organizing learning materials contains squencing which refers to the creation of the order of presentation of learning materials, and synthesis which refers to efforts to show students the relationship between the facts, concepts, procedures and principles contained in the learning materials. In line with this, the Ministry of National Education (2008) stated that the module has more complete components and structures than other teaching materials.

The strategies, models, and teaching materials used by teachers in the learning process are the main aspects to achieve learning goals. Learning experience can be obtained if teachers have the ability to create a learning atmosphere that is in accordance with the characteristics of students and material characteristics (Adnan and Bahri, 2018; Ranti at al., 2024). This is strengthened by the results of research by Bahri et al. (2021) that teaching materials are urgently needed in HOTS-based learning, the use of teaching materials in the form of modules can increase students' motivation to learn and high-level thinking skills and help them learn independently. Therefore, through HOTS-oriented modules, teachers can train students to think critically, creatively, and deeply about subject matter.

Based on this, an analysis of the needs of teaching materials in the form of modules oriented to Higher Order Thinking Skills (HOTS) for high school/MA students in class X was carried out as a means in the learning process. Improving the quality of learning requires the availability of instructional materials that not only deliver information but also foster students' Higher Order Thinking Skills (HOTS). This urgency has prompted an analysis of the development of instructional modules oriented toward HOTS. The purpose of this study is to find out the needs of students for the teaching materials of the modules to be developed.

MATERIALS AND METHODS

1. Time and Place of Research

The research was carried out in October 2022. The research was conducted in October 2022. It was carried out in ten schools, involving biology teachers from UPT SMA Negeri 5 Soppeng, UPT SMA Negeri 2 Pinrang, UPT SMA Negeri 9, UPT SMA Negeri 8, UPT SMA

Negeri 1 Makassar, UPT SMA Negeri 1 Dapurang, UPT SMA Negeri 1 Talapang Barat, UPT SMA Negeri 3 Takalar, SMA Aksara Bajeng, and SMAS IT Nurul Asafa Takalar.

2. Types of Research

This research is a descriptive qualitative study aimed at analyzing the needs for developing a learning module oriented toward Higher Order Thinking Skills (HOTS). Data were collected through observations and questionnaires, which were analyzed to design a module that meets the needs of both students and teachers.

3. Research Methods and Data Collection

The research instruments used are checklists of lesson plans and modules for the analysis of learning tool documents as well as processes and questionnaires of teacher and student responses to analyze students' needs for the modules to be developed. The data collection technique is carried out through 2 methods, namely the documentation method to analyze the biology learning process through teacher learning tools, and the survey method to analyze the needs of teachers and students. The data collection process is carried out by providing questionnaires to biology teachers and students through the google form link to find out and analyze what students need and overcome learning problems that occur. Meanwhile, the analysis of the biology learning process is carried out by analyzing learning tool documents, namely the Learning Implementation Plan and modules used by teachers with the aim of finding out the problems that occur in the field.

4. Population and Sample

The population of the study consisted of senior high school biology teachers. The research sample included 10 biology teachers from various schools, including those from UPT SMA Negeri 5 Soppeng, UPT SMA Negeri 2 Pinrang, UPT SMA Negeri 9, UPT SMA Negeri 8 (mentioned twice), UPT SMA Negeri 1 Makassar, UPT SMA Negeri 1 Dapurang, UPT SMA Negeri 1 Talapang Barat, UPT SMA Negeri 3 Takalar, SMA Aksara Bajeng, and SMAS IT Nurul Asafa Takalar.

5. Data Analysis

Data analysis in the study was carried out by reducing the data obtained from the results of documentation and surveys. The data obtained from the research results were then presented descriptively so as to produce research conclusions regarding the need for the development of teaching materials in the form of HOTS-oriented modules.

RESULTS AND DISCUSSION

The analysis of the lesson plan used by teachers in biology learning activities at school is carried out to find out the obstacles and problems that occur in teaching and learning activities. The results of the analysis can be seen in Table 1.

Table 1. Results of Analysis of the Biology Teacher Lesson Plan

No.	Aspects Analyzed	Sum	Percentage (%)
1	Learning objectives meet the ABCD (Audiance, Behavior, Condition, Degree) component	4	40,00
2	Cognitive level within learning objectives		
	a. Remembering (C1)	6	14,63
	b. Understanding (C2)	23	56,10
	c. Apply (C3)	0	0,00
	d. Analyze (C4)	8	19,51
	e. Evaluate (C5	0	0,00
	f. Creating (C6)	4	9,76

The results of the analysis of the lesson plan used by teachers in Table 1 show that the learning objectives that meet the ABCD component are only 40%, which means that only 4 out of 10 teachers implement the use of the Audiance, Behavior, Condition, Degree (ABCD) component.

Meanwhile, the cognitive level in the learning objectives is dominated by the cognitive level of understanding (C2) and the accumulated percentage of LOTS content (cognitive level C1-C3) in the aspect of learning objectives is 70.73% and the content of HOTS (cognitive level C4-C6) in the aspect of learning objectives is only 29.27%.

The analysis of the lesson plan used by teachers in Biology learning shows that the learning objectives that follow the ABCD component are still low, which is 40%. According to Prastowo (2015), learning objectives should include competencies and follow the applicable rules by fulfilling the ABCD component. The components of audience, behavior, condition, and degree are considerations for formulating learning objectives that are in accordance with the learning environment.

Preparing good learning objectives is very important because learning objectives become orientation during learning. In line with this, Hamalik in Warsito (2017) stated that learning objectives are a description of the behavior that is expected to be achieved by students after learning. Meanwhile, Agustina & Jumadi (2020) said that if incomplete learning objectives cause teachers to have difficulty assessing learning.

In addition, the learning objectives contained in the lesson plan analyzed are mostly still at the LOTS level. According to Kristiyono (2018), the learning process that uses LOTS only emphasizes students on the ability to memorize things conveyed by the teacher, where students tend to be inactive or passive, and unable to recognize and solve problems on their own. The data shows that the percentage of HOTS use in compiling learning objectives is still very low and is dominated by low-level thinking skills or LOTS.

The use of modules in the learning process as implemented by several teachers is then analyzed to find out the criteria and completeness of the modules used. The results of the module analysis can be seen in Table 2.

Table 2. Results of Analysis of Modules Used by Teachers

No.	Module Components	Sum	Percentage (%)
1	Heading	10	100
2	Study instructions	3	30
3	Basic competencies, learning objectives, and indicators of competency achievement	6	60
4	Supporting information	3	30
5	Assignment	9	90
6	Evaluation or assessment	4	40

Based on the results of the module analysis, it is known that the modules used by 10 biology teachers in the field have not met the module component criteria recommended by the Ministry of National Education. This can be seen from the accumulation of the percentage of components contained in the module, where only 30% of the modules contain learning instructions and supporting information, 60% of the modules contain basic competencies and learning objectives, and only 40% of the modules contain assessments. However, 90% of the modules used by teachers have already contained assignments and 100% have contained titles.

The results of the analysis of module components used by teachers show that the percentage of module component completeness is still low. This is not in line with the statement of the Ministry of National Education (2008) which states that the formulation of module components includes titles, learning instructions, basic competencies, indicators of learning objectives, supporting information, materials, assignments, and assessments. Based on the results of the analysis, the researcher felt the need to develop a module that contained good and correct module components.

The assignment and assessment components contained in the modules used by teachers are analysed to find out the cognitive level of the assignments and assessments given by teachers to students. The results of the analysis can be seen in Table 3.

Table 3. Results of Cognitive Level Analysis on Assignments and Assessments on Modules Used by Teachers

No.	Cognitive Level	Sum	Percentage (%)	Information
1	Remembering (C1)	47	48,96	
2	Understanding (C2)	26	27,08	LOTS
3	Apply (C3)	17	17,71	
4	Analyze (C4)	4	4,17	
5	Evaluate (C5	2	2,08	HOTS
6	Creating (C6)	0	0,00	

Based on the data in Table 3, out of a total of 10 teachers who use the module, most have not reached the HOTS level. This can be seen from the module components, namely the assignment and assessment sections. After analysis, the results were obtained that of the 96 tasks given, as many as 48.96% were in the domain of C1, C2 was 27.08%, C3 was 17.71%, C4 was 4.17%, C5 was 2.08%, and C6 was still 0%.

Analysis of assignments and assessments on the modules used by teachers was carried out to see the cognitive level used by teachers. The assignments given by teachers were more dominant at the LOTS cognitive level which was 93.75% while the assignments at the HOTS cognitive level were only 6.25%. The results of this analysis reveal that the learning objectives and assignments in the modules used by teachers are still dominated at the cognitive level of LOTS or low-level thinking skills. Meanwhile, students are required to have high-level thinking skills or HOTS.

Through high-level thinking skills, students will distinguish ideas or ideas clearly, critically, creatively, argue well, be able to solve problems, be able to construct explanations, be able to hypothesize and understand complex things more clearly, where this ability clearly shows how students reason. In line with this, Adnan, et al (2021); Muchsin, et al. (2021); Prayogi & Estetika (2019) stated that the development of HOTS-oriented learning aims to improve the quality of learning and the quality of graduates in order to prepare graduates with 21st century competencies. This shows that higher order thinking skills are one of the indications of the success of increasing human resources in the field of education.

The analysis of teacher needs was obtained by surveying 10 Biology teachers from different schools. The results of the analysis of teacher needs can be seen in Table 4.

Table 4. Results of Analysis of the Needs of Biology Teachers

No.	Indicators	Sum	Percentage (%)
1	Learning biology material accompanied by modules	10	100
2	Practice high-level thinking skills in the learning process	4	40
3	Using modules that contain HOTS (C4, C5, and C6)	3	30
4	The HOTS module activates students in the learning process	6	60
5	The HOTS module is able to support students to think at a higher level	9	90
6	HOTS modules are important and needed for today's learning	10	100
7	Requires a high-level thinking ability-oriented module to support biology learning	10	100

Based on a survey of 10 biology teachers, data was obtained that only 30% of teachers have used modules that contain HOTS (C4, C5, and C6), 60% of teachers stated that the HOTS module is able to activate students in the learning process, 90% of teachers stated that the HOTS module is able to support students to think at a higher level, and 100% of teachers stated that the HOTS module is important and needed for today's learning. The results of this survey are a reference to develop modules oriented towards higher thinking skills to support biology learning.

The results of the analysis of the biology learning profile in schools show that the thinking skills of students have not been fully trained in the learning process, which is also in line with the level of HOTS in the modules used by teachers is still very low. Where the assignments in the cognitive realm of LOTS are much more than the assignments in the cognitive realm of HOTS. On the other hand, the current Government through the Ministry of Education and Culture (Depdikbud)

expects that learning must contain HOTS and even learning tools such as lesson plans, LKPD, teaching materials and other assessments must contain HOTS, but the facts on the ground are not so.

Analysis of students' needs is also carried out to find out problems and needs to support their understanding in the learning process. The results of the analysis of students' needs and problems can be seen in Table 5.

Table 5. Results of Analysis of Problems and Needs of Students

No.	Indicators	Sum	Percentage (%)
1	Teachers dominate using the lecture method in the learning process	22	73,3
2	Experiencing difficulty understanding the material through teaching materials and methods applied by teachers	19	63,3
3	Have difficulty understanding biological material	25	83,3
4	Look for other teaching materials besides books from the school to help in understanding biology subject matter	25	83,3
5	Likes learning with observation/observation (pictures/videos)	28	93,3
6	Motivated to learn if you use interesting modules	28	93,3
7	Requires a module whose questions can be answered based on the results of observations/direct activities, not just copying what is in the literature/package book	27	90,0
8	Requires a high-level thinking ability-oriented module for biology learning so that the material is easy to understand and contextual	28	93,3

The results of the analysis in table 5 show that the survey of 32 students has various needs and problems in learning biology materials. As many as 73.3% of students considered that teachers were dominant in using the lecture method in the learning process. As many as 63.3% of students have difficulty understanding the material through teaching materials and methods applied by teachers. As many as 83.3% of students have difficulty understanding biology material and looking for other teaching materials other than books from schools to help in understanding biology subject matter. As many as 93.3% of students like learning with observation/observation (images/videos), are motivated to learn if they use interesting modules, and need high-level thinking ability-oriented modules for biology learning so that the material is easy to understand and contextual. In addition, as many as 90.0% of students need modules whose questions can be answered based on the results of observations/direct activities, not just copying those in literature books/package books.

The ideal learning criteria that students want can be met by learning with the help of modules in which there are images/videos that support the material, modules are designed with an attractive appearance, and modules ask questions that can be answered based on the results of observations/direct activities rather than the result of copying from package books or the internet. This is considered ideal for students because it can require them to be able to process their own information so that they can train students' high-level thinking skills (HOTS). Meeting the needs of students is the key to success in the learning process. If the needs of students are met and served effectively and efficiently, then it is very likely that the learning process will increase in the future (Devianti and Suci, 2020).

Based on this, it is necessary to develop teaching materials in the form of HOTS-oriented modules. This is strengthened by the results of research by Bahri et al. (2021) that teaching materials are urgently needed in HOTS-based learning, the use of teaching materials in the form of modules can increase students' motivation to learn and high-level thinking skills and help them learn independently. Meanwhile, according to Shofa et al (2020), students who have difficulty absorbing the material can be assisted with teaching materials and simulations so that students are helped in understanding the material. In addition to improving learning outcomes, the use of teaching materials can also train students in understanding concepts. HOTS-oriented modules can be used by teachers to train and improve students' high-level thinking skills through learning objectives, materials, as well as assignments and assessments presented in modules. The module is expected to support the biology learning process in schools in the independent learning curriculum.

CONCLUSION

Based on the results and discussion, it can be concluded that it is necessary to develop a HOTS-oriented module that can train students' high-level thinking skills. This is based on the results of the analysis which shows that the use of HOTS-oriented modules is still very low and biology learning in schools is still dominated at the cognitive level C1 to C3, namely at the level of low-level thinking ability or LOTS. Students' high-level thinking skills need to be improved. Efforts to improve these abilities can be formed and honed through supportive learning activities. Thus, the role of educators can facilitate students to think at a higher level or HOTS.

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