The Urgency of Higher Order Thinking Skills (HOTS) Base on Development of Biology Assessment Instruments for Class XI Students of SMA/MA

Sa'diatul Fuadiyah(✉), Ganda Hijrah Selaras, Defrian Melta, and Dini Rahmi

Department of Biology, Faculty of Mathematics and Science, Universitas Negeri Padang, Padang, West Sumatra, Indonesia
Sadiyah@fmipa.unp.ac.id

Abstract. A curriculum, or educational program, produces high quality education. The 2013 curriculum, which places a strong emphasis on students' reasoning skills and uses assessment as a yardstick for curricular achievement, is the one that is now being used in Indonesia. In essence, an evaluation makes use of a test as an instrument, including written, oral, and action tests. The test is used to gauge how well pupils are learning by giving them a variety of questions to respond to. In order to meet the learning objectives, the test's instrument should include questions that call for critical thinking abilities like reasoning. The major goal of this study was to evaluate the need for creating biology test questions for class XI SMA/MA students that were based on Higher Order Thinking Skills (HOTS). Observations at SMAN 8 Padang, SMAN 2 Padang, and SMA Pembangunan Laboratory UNP revealed that the cognitive level is still low, namely at C1, C2, and C3, as evidenced by daily assessment questions (PH) on animal tissue material, digestive system material, and plant tissue material. The cognitive level for reasoning abilities is C4. As reasoning, critical thinking, and problem solving are all considered to be higher-order thinking skills, this shows that the question has not been able to motivate pupils to have some good skills. According to the results of the observations, it is crucial to create HOTS-based biology test questions for students in class XI in order to enhance students' critical thinking abilities in locating concepts and information to meet biology learning objectives.

Keywords: Development of Biological Assessment Instruments · Higher Order Thinking Skills · critical thinking · problem solving · students

1 Introduction

Education is considered a very important aspect of creating a quality human generation as well as one of the methods used by the government to harmonize and form a nation that is useful for the country. Education is defined as a series of teaching and training combination implementations in which changing the attitudes of a person or people group is the goal of it [1].

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In practice, the implementation of education is oriented to education quality. PISA (Programme for International Students Assessment) initiated by the OECD (Organization for Economic Co-operation and Development) which evaluates the education systems of several countries around the world can be set as one of the parameters to measure the quality of education [2].

Since 2000/2001 Indonesia has taken part in PISA which is one step to determine students' abilities in mastering, understanding, and applying knowledge in the context of everyday life. Based on the results of PISA Indonesia in 2018 on scientific abilities that require reasoning abilities have an average score of 396 whereas of 79 participating countries, Indonesia was ranked 71 [3]. This ranking is a numerical representation of the outcomes that can be obtained from an educational program's activities, specifically the curriculum.

An instructional program that is systematically planned, organized, and created is known as a curriculum [4]. Now, the 2013 Curriculum has been implemented as a substitute for the Education Unit Integrated Curriculum (KTSP) with the learning principles of the 2013 Curriculum which include three domains of competence, namely attitudes, knowledge, and skills, and emphasizes changing the paradigm of students who are able to reason on concepts [5].

The reasoning is an activity that uses reason, logical thinking, and mental processes in developing thoughts based on facts or principles [6]. The reasoning is a way of thinking that is devoted to drawing conclusions based on existing premises. Referring to the taxonomy of learning objectives that are most often used, namely Bloom's taxonomy. The concept of this taxonomy identifies skills ranging. The cognitive dimension in Bloom's taxonomy considers the level of difficulty in achieving learning objectives which consist of six levels, they are C1, C2, C3, C4, C5, and C6 level; remembering, understanding, applying, analyzing, evaluating, and the last one is creating [7]. The ability to reason is specifically contained in the C4 level and is a required skill in science learning such as studying biology.

Biological materials that train students to be able to reason such as critical thinking are mostly found in Basic Competencies (KD) of class XI, high school, and Madrasah Aliyah (SMA/MA) grades, including; (1) KD 3.3; analysis of the relationship from cell's structure both of tissues also organ functions in the plant; (2) KD 3.4; namely Analyze the cell structure in animal tissues and organ functions for its relationship; and (3) KD 3.7, namely Analyze the relationship of organs in the digestive system (relation to nutrition, bioprocesses, and functional disorders) human digestive system that make up from the structure of the tissue. Teachers can determine the ability to reason and think critically and determine the involvement of students in learning related to these materials through assessment.

Assessment in education is a research aid tool in education and educational practice which in the process requires instruments [8]. As a tool, the assessment should measure the goals effectively and efficiently [9]. The instrument must be in accordance with the object, and the conditions of measurement. Broadly speaking, assessment instruments in education can be categorized into 2 groups, namely test, and non-test. The test is a deliberate and methodical process for assessing a person's conduct or an objective evaluation of a person's behavior so that it can be quantified or categorised.

This research is oriented in the context of biological test instruments that can improve the abilities of reasoning, and critical thinking (reasoning assessment) or commonly known as HOTS (Higher Order Thinking Skill) students as an effort to achieve learning goals and higher-order thinking skills. Reasoning assessment is an activity of collecting evidence that is carried out intentionally to make a connection between experience and knowledge in order to explain what is seen, thought, and concluded, then an assessment containing reasoning questions (critical thinking skills) can train students to try to answer questions which is difficult whose information is not found at that time rationally [10].

Based on observations made at UNP Laboratory Development High School, SMAN 2 Padang, and SMAN 8 Padang through the questions used by the teacher (daily assessment questions for the odd semester for the 2021/2022 school year). The goal of the study was to assess the need for creating biology test questions for class XI SMA/MA students that would need Higher Order Thinking Skills (HOTS).

2 Methods

This study qualifies as a qualitative descriptive one. In order to address these issues, the research can offer an overview of the issues that develop in learning, followed by relevant answers. This study's participants were three senior high schools (SMA) in the city of Padang: SMA Pembangunan Laboratorium UNP, SMAN 2 Padang, and SMAN 8 Padang. For the academic year 2021–2022, class XI students from each school participated in this study. This study uses descriptive statistical analysis techniques that can provide an overview of the cognitive level of biological material, specifically about the daily assessment (PH) of students.

3 Result and Discussion

3.1 Results

Based on the observations that have been made, the cognitive domain data on daily assessment questions (PH) on material for class XI SMA/MA, especially plant tissue, animal tissue, and the digestive system obtained the following results.

3.2 Discussion

The analysis results of the questions' cognitive level on biology material show that the daily assessment questions made by the teacher are fully dominant at the level of ability to remember (C1) to understanding (C2) and have not reached the level of critical thinking (at least the ability level C3 to C6). The results of the analysis of the cognitive level of the assessment instrument for the daily assessment of plant tissue material at the UNP Laboratory Development High School (Table 1) show that the teacher makes questions with the cognitive domain of C1 (remembering) as much as 20%, cognitive domain C2 (understanding) as much as 60%, and the cognitive domain C2 (understanding) as much as 60%. Cognitive C3 (apply) as much as 20%. Plant tissue material is contained in KD 3.3 with the aim of learning that can be achieved by students through analyzing

Table 1. Cognitive domain about the daily assessment of plant tissue material at the UNP Laboratory Development High School

Cognitive Level	***Percentage***
C1 (remembering skill)	20%
C2 (understanding skill)	60%
C3 (applying skill)	20%
C4 (analyzing skill)	0%
C5 (evaluating skill)	0%
C6 (creating skill)	0%
Total	100%

Table 2. Cognitive domain of daily assessment of animal tissue material at SMAN 8 Padang

Cognitive Level	***Percentage***
C1 (remembering skill)	8%
C2 (understanding skill)	44%
C3 (applying skill)	48%
C4 (analyzing skill)	0%
C5 (evaluating skill)	0%
C6 (creating skill)	0%
Total	100%

Table 3. Cognitive domain about daily assessment of digestive system material at SMAN 2 Padang

Cognitive Level	***Percentage***
C1 (remembering skill)	44%
C2 (understanding skill)	36%
C3 (applying skill)	20%
C4 (analyzing skill)	0%
C5 (evaluating skill)	0%
C6 (creating skill)	0%
Total	100%

activities, actually about the relationship between cell structures and the function of organs in plants. However, the daily assessment of plant tissue material at the UNP

Laboratory Development High School does not yet contain the cognitive domains of C4 and C5, moreover C6. Daily assessments are carried out by teachers periodically and are carried out at the end of certain Basic Competence (KD) learning [11]. So that the questions on the daily assessment should be made with the right cognitive level to suit the learning objectives to be achieved.

Table 2 reveals that the daily assessment of animal tissue material at SMAN 8 Padang is dominated by the C3 cognitive domain, which is 48%, followed by the C2 cognitive domain as much as 44%, and the C1 cognitive domain as much as 8%. There were no questions containing operational verbs (KKO) of C4, C5, or C6 cognitive domains. The learning objective of KD 3.4 class XI is that students are able to analyze the relation of animal tissues, such as cell structure and organ functions, so questions with KKO analysis need to be included in the daily assessment instrument for animal tissue material. Because critical thinking abilities like reasoning are required to meet learning objectives, especially when it comes to animal tissue material, analyzing activities is very directly tied to the activities or abilities of students in obtaining concepts and knowledge [12]. In order to generate the best learning decisions, the proper test instrument can be employed as a comprehensive and accurate evaluation of the attainment of student learning outcomes [10].

According to Table 3, there are no daily assessment questions at SMAN 2 Padang, particularly for the class XI material on the digestive system, from the cognitive domains C4, C5, and C6. As many as 44% of the PH questions are included in the C1 cognitive domain, as many as 36% of the questions contain operational verbs that characterize the C2 cognitive domain, and as many as 20% are questions in the C3 cognitive domain. This indicates that the test instrument used has not been able to describe the achievement of student learning objectives related to the material of the digestive system, especially at SMAN 2 Padang. Teachers can make arrangements such as the cognitive level of questions in the assessment used so that learning and learning can achieve curriculum goals [13].

The study's findings indicate that it was important to create a biological assessment tool based on HOTS for class XI SMA/MA pupils. The significance of this study is that teachers are expected to be able to develop and use appropriate assessment instruments in the biology learning process so that they can help students hone and train their reasoning skills so that they are accustomed to answering questions that train reasoning skills such as critical thinking, especially about plant tissue material, animal tissue, and digestive system.

4 Conclusion

The research's conclusion is that a biological assessment tool with a Higher Order Thinking Skills (HOTS) Base is required for class XI SMA/MA students. HOTS-based test questions can improve students' reasoning abilities such as critical thinking where someone can answer difficult questions with a high cognitive level.

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