REID (Research and Evaluation in Education), 7(2), 2021, 177-185
Available online at: http://journal.uny.ac.id/index.php/reid

Profile of the ability of prospective Biology teachers in making question instruments using Bloom's Taxonomy

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ARTICLE INFO

Article History
Submitted:
1 November 2021
Revised:
6 December 2021
Accepted:
24 December 2021

Keywords
Bloom's taxonomy; LOTS; HOTS; prospective teacher

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ABSTRACT

The purpose of this study is to determine students' ability to make Bloom's taxonomy questions. The study was conducted on students in the 5th semester of the 2020/2021 academic year who were taking evaluation courses and learning achievement techniques with a sample of 62 people. This research is a descriptive study using a checklist sheet as the main instrument that has been content validated by experts, questionnaires, and interviews as supporting data. Data were analyzed using the quantitative descriptive method. The results of the research show that students have very good abilities in making Bloom's taxonomy questions for the lower other thinking skills category with a percentage of 92.22% with details C1 100%, C2 95%, and C3 81.67%, while the students' ability in making questions with a higher level of other thinking skills is in the very poor category with a percentage of 44.17% with C4 54.17%, C5 46.67% and C6 31.17%. In addition, based on the form of questions, students' ability to design essay questions (74.17%) is better than multiple-choice questions (62.22%). The conclusion of this study is the ability of students to make questions based on Bloom's Taxonomy is in the fairly good category, with a percentage of 78.06%.

How to cite:
Idris, T., Ferazona, S., & Safitri, H. (2021). Profile of the ability of prospective Biology teachers in making question instruments using Bloom's Taxonomy. *REID (Research and Evaluation in Education), 7*(2), 177-185. doi:https://doi.org/10.21831/reid.v7i2.44903

INTRODUCTION

The use of Bloom's Taxonomy in assessment is something that is ingrained in Indonesia. All levels of education use Bloom's Taxonomy as an instrument to see the achievement of learning outcomes (Bloom et al., 1956). Bloom's Taxonomy concept was developed by Benjamin S. Bloom in 1956. Bloom's Taxonomy consists of three domains, namely the cognitive, affective and psychomotor domains (Krathwohl, 2002). In 2001, Bloom's Taxonomy was revised by dividing it into two domains, namely the knowledge domain consisting of factual, conceptual, procedural and metacognitive and the cognitive process domain consisting of remembering, understanding, applying, analyzing, evaluating and creating (Waite et al., 2020). Taxonomy is a classification system that provides a hierarchical hierarchy of things or principles or concepts that are tiered (Van Niekerk & Von Solms, 2013). These levels ultimately lead to disagreements among educational and psychological experts who think that the human brain is not like a computer which has steps and levels that must be passed to achieve something (Arievitch, 2020).

The use of Bloom's Taxonomy is very broad in education covering various fields of knowledge and perspectives (Pappas et al., 2013) such as in the accounting (Kidwell et al., 2013), Medical (Ghidinelli et al., 2021), reading activities (Tangsakul et al., 2017), and writing (Baghaei et al., 2020), in Mathematics (Radmehr & Drake, 2017; Risnawati et al., 2019), Engineering (Meda &

Swart, 2018), and Science (Lee et al., 2015). In addition, the Bloom's Taxonomy can be used to cognitive goal and thinking levels (Van Niekerk & Von Solms, 2013), determine mastery of exam questions (Ebadi & Shahbazian, 2015; Momsen et al., 2013) and in evaluating textbooks as in (Parsaei et al., 2017; Sahragard & Alavi, 2016).

The teacher is one of the spearheads of educational progress, thus, a teacher must be able to measure learning progress with various instruments that have been studied such as to measure cognitive aspects using questions, to measure psychomotor aspects using performance assessments and for affective aspects using non-test instruments such as observation sheets (Johnson et al., 2021). The teacher's ability to make questions is an implication of learning evaluation courses at the home campus. According to Hadiprayitno et al. (2019), most students (≥70%) had difficulty in learning biology material. This difficulty is in line with the difficulties of teachers in developing assessment instruments.

The Biology Education Study Program, Faculty of Teacher Training and Education, Islamic University of Riau is one of the Education Personnel Education Institutions that produces prospective biology education teachers. As that role is to equip students in teaching, evaluation courses are required for prospective teacher students to help them measure the learning abilities of students later. Evaluation courses and techniques for achieving biology learning outcomes are taken in semester 5, one of which is Bloom's Taxonomy. The learning outcome of this material is that students are able to design, apply, evaluate and make evaluation tools in measuring the cognitive, affective and psychomotor domains using Bloom's Taxonomy. The purpose of this study was to determine the ability of prospective biology teacher students in the Biology Education Study Program in making questions based on Bloom's Taxonomy. This study provides important implications for the learning process or subsequent lectures, because these findings will be input to the learning process in the evaluation course and the achievement of biology learning techniques in the Biology Education Study Program in particular and evaluation courses on all campuses of Educational Personnel Education Institutions in general.

METHOD

This research is a descriptive study using a checklist sheet instrument, interviews and questionnaires. The research was conducted at the Biology Education Study Program, Faculty of Teacher Training and Education, Islamic University of Riau, Academic Year 2021/2022. The research sample is all students who have taken evaluation courses and biology learning outcomes achievement techniques in semester 5, as shown in Table 1.

The data used to answer the problem formulation are questions made by students on the topic of Bloom's taxonomy. There are two kinds of questions, namely multiple choice and essay. Meanwhile, to find out students' perceptions of their abilities, a limited questionnaire was given. The research instrument uses a checklist sheet that has been content validated by experts. The data is calculated by Formula (1), in which P = Percentage, F = Frequency, and N = Number of samples (Spuck et al., 1975). After that, it is categorized based on the criteria (Asrul et al., 2014) as shown in Table 2.

Table 1. Population and Research Sample

Class	Population	Sample
5A	31	31
5B	31	31
Total	**62**	**62**

$$P = \frac{F}{N} X100 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Table 2. Categorization of Students' Ability to Make Cognitive Questions

Achievement	Category
86 – 100%	Very Good
76 – 85%	Good
60 – 75%	Fairly Good
55 – 59%	Poor
≤ 54%	Very Poor

FINDINGS AND DISCUSSION

Findings

Based on the results of the study, data were obtained from the results of students' abilities in making questions based on Bloom's Taxonomy with the category of Lower Order Thinking Skills. Based on Table 3, it can be seen that the overall ability of students in making questions in the LOTS category is in the very good category with a percentage of 92.22%. In the Given category (C1), the ability of the two classes is the same, namely each is very good with an average of 100%, this means that all students are able to make C1 questions correctly. In the matter of understanding C2, 95% of students were able to make questions correctly, both on multiple choice questions and on objective questions. Meanwhile, in making C3 questions, the students' ability to apply obtained a percentage of 81.67% with a good category.

Table 4 shows that the overall ability of biology education students in making HOTS-type questions is in the very poor category with a percentage of 44.17%, in class A it is 46.11 while in class B it is 42.22% each in the very poor category. Based on high-level thinking skills, the ability to make C6 (Creating) questions is the lowest with a percentage of 31.67% while the ability to analyze is in the less category with a percentage of 54.17%. As for the ability of students in making evaluation questions, it is still in the poor category with a percentage of 46.67%.

Based on Figure 1, it can be seen that the students' ability in making questions based on Bloom's taxonomy is in a fairly good category with a percentage of 68.18%. whereas when viewed in each class, it is not much different, namely in the fairly good category with class A getting a percentage of 69.64% and class B by 66.94% the ability of students in making questions with the LOTS type is very good while the HOTS type is still lacking.

Table 3. Student Ability to Make LOTS Questions

Indicator	Class A	Class B	Average	Category
Remember	100.00	100.00	100.00	Very Good
Understand	95.00	95.00	95.00	Very Good
Apply	83.33	80.00	81.67	Good
Average	**92.78**	**91.67**	**92.22**	**Very Good**
Category	**Very Good**	**Very Good**	**Very Good**	

Table 4. Student Ability to Make HOTS Questions

Indicator	Class A	Class B	Average	Category
Analyze	58.33	50.00	54.17	Poor
Evaluate	48.33	45.00	46.67	Very Poor
Create	31.67	31.67	31.67	Very Poor
Average	**46.11**	**42.22**	**44.17**	**Very Poor**
Category	**Very Poor**	**Very Poor**	**Very Poor**	

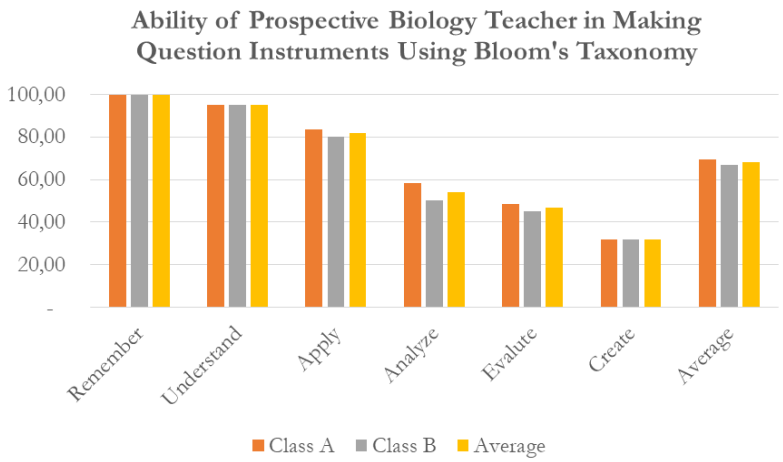

Figure 1. The Ability to Create Bloom's Taxonomy Questions

Table 5. Students' Ability in Making Questions Based on the Type of Questions

Level	Type of Questions			
	Multiple Choice	Category	Essay	Category
C1	100.00	VG	100.00	VG
C2	93.33	VG	96.67	VG
C3	73.33	FG	90.00	VG
C4	46.67	VP	61.67	FG
C5	33.33	VP	60.00	FG
C6	26.67	VP	36.67	VP
Average	**62.22**	**FG**	**74.17**	**FG**

Based on Table 5, it can be seen that the ability of students in making essay type questions is higher than that of multiple choice questions. In multiple choice and essay types, the average ability of students is in the sufficient category with a percentage of 62.22% for multiple choice questions and 74.17% for essay questions.

Discussion

Based on Figure 1, it shows that the average ability of prospective biology teacher students in the Biology Education Study Program, Faculty of Teacher Training and Education, Islamic University of Riau in making Bloom's taxonomy questions is in the fairly good category with a percentage of 78.06% in the fairly good category. The ability to make questions in the category is very good at the level of lowers other thinking skills and the category is very poor at questions of higher other thinking skills.

Bloom's taxonomy refers to a taxonomy created for learning purposes, namely student learning outcomes. This taxonomy was first compiled by Benjamin S. Bloom, Kartwohl, and friends in 1956. Bloom's taxonomy is the most influential taxonomy in the world compared to other taxonomies, more than 60 countries have used it in education. Bloom's taxonomy is considered the taxonomy that best meets educational needs and is very easy to measure because it is equipped with Operational Verbs at each level completely with a clear hierarchy (Anderson et al., 2001). The use of Bloom's taxonomy is very broad in education covering various fields of knowledge and perspectives (Pappas et al., 2013).

During the process of making Bloom's taxonomy questions, there are several obstacles faced by students including the difficulty of distinguishing between understanding and applying questions, the available operational verbs are actually very helpful for students in making questions but in the application the questions made are not in accordance with the selected operational verbs. In addition to the aforementioned constraints, questions with a higher level (HOTS),

some of the information presented in the questions is not good enough so that the questions that are made end up being questions with level C2 or C3. To support students' ability to design and create questions using Bloom's taxonomy, the supervisor provides direct examples of using operational verbs according to their level and the results of the questionnaire show that HOTS questions are difficult material for students, so they require special assistance and a longer time to study it. In designing and developing learning innovations, it is important to focus on supporting the process of constructing and reflecting students' knowledge rather than conveying and memorizing principles and facts (Hooshyar et al., 2019).

Based on the data from Table 3, it can be seen that the students' ability in making questions with lower other thinking skills or LOTS consisting of questions with the ability to remember (C1), questions with the ability to understand (C2) and questions with the ability to apply (C1) C3) (Prakash & Litoriya, 2021). Based on the aforementioned data, it can be seen that the average ability of students in making questions with the LOTS type is in the very good category with a percentage of 92.22%. This is in line with a research by Lee et al. (2015) which shows that the item questions used by the majority of teachers are in the LOTS category. The ability of students to make LOTS questions is very important to measure students' basic abilities later as a basis for higher thinking (Krathwohl, 2002).

The ability of students to develop evaluation tools is very important because it is the bsasis for teachers in measuring learning success. The more difficult it is for the teacher to make questions, the student's ability to learn will also be difficult because learning activities cannot be measured properly. This is in line with research conducted by Hadiprayitno et al. (2019) which showed that most students (≥70%) had difficulty in learning the Biology material. This difficulty is in line with the difficulties of teachers in developing assessment instruments.

In addition to LOTS questions, prospective biology teacher students must also be able to make questions with high-level criteria called HOTS (Higher Other Thinking Skills). Higher order thinking ability is an activity/thinking process that is directed at manipulating ideas and information in a certain way that can provide new understanding for students (Retnawati et al., 2018) There are three levels in higher order thinking according to Bloom's taxonomy, namely (1) analyzing, which can be in the form of analyzing information which is then classified, identifying the causes and effects of an event and identifying questions; (2) evaluating, which means providing assessment and analysis using certain criteria, checking and speculating and accepting or rejecting arguments with clear criteria; (3) creating, which consists of shared perceptions of point of view, modeling problem solving and innovating (Krathwohl, 2002).

In addition to HOTS, according to Bloom's taxonomy, several researchers and experts have different views, such as in the research of Dillo and Scott (2002), Miri et al. (2007), Zohar and Dori (2003) which found that HOTS consists of the ability to analyze, synthesize, evaluate, develop skills to estimate, generalize, create thoughts, make decisions and think critically and systematically (Kwangmuang et al., 2021). According to Dillo et al. and Kangmuang et al., HOTS consists of critical thinking, creative, problem solving and decision making (Retnawati et al., 2018). HOTS can also only consist of two components: critical and creative thinking (Sulaiman et al., 2017). According to Prakash and Litoriya (2021), HOTS is an important element in education because of its benefits in improving student achievement, reducing weaknesses, interpreting, synthesizing, solving problems, and controlling information, ideas and daily activities.

Based on Table 4, it can be seen that the ability of students in making HOTS questions is in the very poor category with a percentage of 44.17%. The poor category in all research objects, both in class A and class B, if seen from each, increases HOTS both at levels C4 - C6 all in the less category. The results of this study are in line with the findings of Arti and Hariyatmi (2015) showing that the ability of teachers at SMAN Wonosari Klaten in making questions C4 (15.2%) C5 (3%) and C6 (3%) is still very low. From interviews with research subjects, information was obtained that the difficulty faced was to make questions according to the operational verbs of each level. In addition, providing a number of information that can be processed to make ques-

tions with HOTS is also not easy. To help students understand and be able to make HOTS questions, the course supervisor provides feedback on assignments and presentations that have been made by presenting students. Schut et al. (2020), Deiglmayr (2018), and Sargeant (2015) support this statement, namely that providing feedback will make the learning process more effective. From the input on learning that was captured after the lecture was over, specifically on materials that were considered difficult or wrong for HOTS, students hoped that the time would be increased and there would be a detailed explanation from the course supervisor.

The questions commonly used by educators to measure the cognitive domain are limited response types in the form of multiple choice questions and essay questions. Multiple-choice test questions can be used to measure learning outcomes that are more complex and related to aspects of memory, understanding, application, analysis and evaluation (Stringer et al., 2021). Multiple-choice test questions consist of the subject matter carrier and answer choices. The main issuer can be stated in the form of a rudimentary question or statement which is often called a stem, while the answer choices can be in the form of words, numbers or sentences and are often called options (Chin et al., 2021). The answer choices consist of the correct answer or the most correct answer which is called the answer key and the possible wrong answer is called a distractor (distractor/decoy/fails), but allows someone to choose it if they do not master the material asked in the question (Hingorjo & Jaleel, 2012; Sahoo & Singh, 2017). In addition, essay questions are questions that are used to measure the cognitive domain which consist of description questions whose answers are limited (restricted response essay items) or objective description questions and description questions whose answers are more unlimited (extended response essay items) or non-objective description questions (Ramesh & Sanampudi, 2021).

Based on Table 5, on average, students' ability to make questions in the essay category is higher (74.13%) than multiple choice questions (62.22%). Moreover, if viewed from each level, the questions C1, C2 and C6 have the same category, which is both very good (C1 and C2) and less than once (C6). For C1 and C2, the questions are in the easy category, so that students can make different types of questions as well as C6 questions because they are very difficult, so students cannot make different types of questions. Meanwhile, there are differences in categories in making questions including those at levels C5, C4 and C3. These data indicate that students' ability is better in making essay questions compared to multiple choice. According to students, essay questions are easier to use because they are not tied to alternative answers so that using operational verbs can be made directly. The difficulty in making multiple choice questions apart from making alternative answer choices, creating and providing information that is used to be processed is also equally difficult.

CONCLUSION

Based on the research that has been done, it is concluded that the ability of prospective teacher students in making questions using Bloom's Taxonomy is in the fairly good category with a percentage of 78.06%.

ACKNOWLEDGMENT

The authors would like to thank the DPPM of the Islamic University of Riau as a provider of research funds and not to forget the Study Program and students of Biology Education, Faculty of Teacher Training and Education, Islamic University of Riau, where the research was conducted.

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