Analysis of the Questioning Ability of Biology Education Students Based on Cognitive Level in Plant Morphology Course

Neni Murniati(✉) and Yennita Yennita

Program Studi Pendidikan Biologi, Fakultas Keguruan dan Ilmu Pendidikan, Universitas Bengkulu, Jl. W.R. Supratman, Kandang Limun, Bengkulu 38122, Indonesia
nenimurniati@unib.ac.id

Abstract. The ability to ask questions about plant structure is very important in learning to empower student problem solving. This study aims to determine the questioning ability of biology education students at Bengkulu University during teaching and learning process of Plant Morphology course. The sample of this study was Biology Education students who enrolled plant morphology course. The students' questioning ability was analyzed based on the number of questions and the quality of the questions asked by the students. The number of questions was then presented as a percentage and the quality of the questions was analyzed based on the cognitive level and categorized as LOTS or HOTS. Qualitative analysis was conducted to determine the students' questioning ability about the learning process of plant morphology. The results showed that 58, 67% of all students have asked questions at the cognitive level C1–C5. The percentage of the students' questioning ability at C1 level is 16.67%, C2 is 30.56%, C3 is 30.56%, C4 is 19.44% and C5 is 2.78%. The students' questioning ability in plant morphology courses was in the category of Low Order Thinking Skill (LOTS) about 77.79% and High Order Thinking Skill (HOTS) about 22.21%. In the future, it is hoped that the students' questioning ability can be improved so that they can create a level of thinking with High Order Thinking Skill (HOTS).

Keywords: questioning ability · biology education · plant morphology course

1 Introduction

Asking is one of the most important pedagogical tools and has been widely used in formal or informal educational settings [1]. Asking is an important strategy to communicate about academics effectively and instructionally [2]. Asking questions is the basis of the learning and teaching process which also encourages wider student learning opportunities [3] such as remembering, understanding, thinking, problem solving [4], increase curiosity, and increase student creativity in learning [5]. Therefore, the ability to ask questions is expected to be possessed by all students.

The learning process in the classroom is dominated by asking questions. All learning and learning process lies in the art of asking [5]. Asking can be an effective learning tool

M. L. Firdaus and A. Defianti (Eds.): MASEIS 2021, ASSEHR 718, pp. 210–216, 2023.
https://doi.org/10.2991/978-2-38476-012-1_28

on the condition that the questions used must have a purpose and be clearly communicated [3]. Teaching students to ask and answer questions is very important if they are to be involved in the process of argumentation, problem solving, and learning. Students in the condition of asking questions based on cognitive level obtained higher reasoning and problem solving scores than others with different conditions [6]. We can also see this case at the students during plant morphology lectures.

Plant morphology is a subject at the biology department and biology education study program. Plant morphology is the study of the shape and arrangement of the outer structure of plants. The study of the outer structure of the plant, for example, on the morphological characteristics of tree species that have different rainfall or developmental conditions that are not yet known [7]. In the process of learning plant morphology, it encourages students to have discussions. During the learning discussion process, students can ask questions. The student's question relates to the problem solving process. Questions that can be asked related to the main material in plant morphology include structure; leaf, stem and root morphology; flower morphology; fruit morphology and seed morphology [8]. However, the level and quality of the questions asked by students has not yet been assessed.

The quality of student questions can be measured by referring to the cognitive level of Bloom's Taxonomy [9]. The cognitive level of the questions is seen in terms of Lower Order Thinking Skills (LOTS) or Higher Order Thinking Skills (HOTS). LOTS consists of C1 (knowledge), C2 (Understanding) and C3 (Application), while HOT consists of C4 (Analysis), C5 (Evaluation), and C6 (Creating). Students in cognitive questioning conditions will be more interactive and get better reasoning and problem solving scores. This happens when the lecturer encourages students to discuss together, and interact with each other more broadly. The lecturer's encouragement to students towards solving through the ability to ask questions is very important to help students in higher order thinking [6]. Higher cognitive ability correlates with behavior [10] followed by learning motivation and various other factors also affect student cognitive [11, 12].

Investigating student behavior is an increasingly important topic in learning, namely the behavior of a person's individual [13]. One of them is the ability to ask students. Questioning technique can improve students' speaking ability in terms of accent, grammar, vocabulary, fluency, and comprehension, where speaking fluency is the highest achievement of all. In addition, it causes students to have good self-confidence and class participation. In short, the more students use questioning techniques, the better their speaking skills will be [14]. For example level cognitive relates to understanding (explaining), then higher cognitive levels, referring to cognitive processes that lead to application to the level of creation. One must find the "main point" of each of the six cognitive levels as the main category on the ability complexity scale being assessed. The hope is that a complete scale of one's abilities will be formed starting from the simple level to the complex level. Using tables to group by objectives, activities, and assessments provides a clear, concise, and concise representation of the picture [15]. So that it can improve learning delivery planning as well as stimulate the students' questioning ability based on their cognitive level.

The importance of questions in the learning process encourages the need to analyze how well the level of questioning ability of biology education students in plant morphology courses based on cognitive level.

2 Research Method

This research is a type of survey method research with a qualitative descriptive approach. The research was conducted on plant morphology courses. The population of this study was all students at biology education study program of University of Bengkulu who enrolled plant morphology courses with a total of 75 students.

The research instrument used was an observation sheet to measure the students' questioning abilities. The research observation data was in the form of the students' questioning ability that they asked during the plant morphology lecture which included the material on single leaf structures, compound leaf structures, and leaf edges. The students' questioning ability was analyzed descriptively based on the number of questions and the quality of the questions that had been asked. The number of questions was then presented based on the quality of the questions based on Bloom's taxonomy cognitive level and grouped into LOTS or HOTS.

3 Results and Discussion

The Analysis of the results and quality of student questions in the plant morphology course is presented in Table 1.

Based on Table 1, the overall percentage of students who ask questions is 23%. There are77% of students did not ask. Regarding to the cognitive level of the questions asked by students, the level of C1 (knowledge) is 13.04%, C2 (understanding) is 42.03%, C3 (application) is 27.54%, C4 (analysis) is 15.94%. And C5 (evaluation) of 1.45%. There is no C6 cognitive level (creating) in the questions asked by students in the plant morphology course. The quality of questions asked by students was 82.61% containing cognitive levels of C1–C3, only 17.39% of students asked at cognitive levels of C4–C6. Therefore, the students' questioning ability was still categorized as Low Order Thinking Skill (LOTS).

Asking questions affects the thinking ability and cognitive abilities of students in the learning process that interacts with other students [16]. This is influenced by learning and the level of student courage in achieving the ability to ask questions [17]. Questions raised by students can improve understanding skills [18]. Furthermore, students who have high-level questioning techniques can improve their speculative, inferential, and evaluative thinking skills [2]. Students with high verbal ability usually ask more desired questions and increase the number of questions. This indicates that the question aims to increase students' self-confidence [19].

The ability to ask someone is always related to the cognitive level. Based on Bloom's taxonomy theory of school learning and the philosophy of mastery of learning asserts that almost all students are able to achieve a high level of learning if given the appropriate conditions, before and simultaneously [20]. Importance Bloom's taxonomy provides an alternative and space in creating a balanced cognitive classification system for students

Table 1. Result of Questions and Quality of Student Questions in Plant Morphology Course

No	Theory	Number of students	Number of Students Asking	Cognitive Level Questions					
				C1	C2	C3	C4	C5	C6
1	Part and structure of a single leaf	75	20	3	8	4	4	1	0
2	Edge, flesh, color and leaf surface	75	12	3	3	3	3	0	0
3	Compound leaves	75	12	0	8	4	0	0	0
4	stem	75	16	3	6	5	2	0	0
5	Root		9	0	4	3	2	0	0
Amount		**300**	**69**	**9**	**29**	**19**	**11**	**1**	**0**
Percentage		**23**		**13.04**	**42.03**	**27.54**	**15.94**	**1.45**	**0**

through the teaching and learning process as well as in the assessment system, including the students' questioning ability [21].

Cognitive boost has been shown to be significant in activating students' prior knowledge, making the learning process more meaningful and focused [22]. Therefore, the ability to ask questions is needed to accommodate this. The use of higher-order cognitive-based questions can also stimulate critical thinking. This is also commonly seen in the form of tests found in textbooks as an important guide for learning and evaluation [23]. Developing higher-order thinking through the strategy of asking students is very necessary. Availability of time, class climate and peer interaction are needed as high-level questioning strategies that have an impact on student achievement [18].

Naturally, questions that ask for a reasoning answer, require depth of information processing [16, 18].When questions are asked during the learning process or discussions take place, they are always related to the subject matter being studied. Good questions avoid passive thinking but require students to actively process the text and turn it into meaningful terms. CaseThis can be helped by manipulation of the disfluency that affects the fluency of student perceptions, which ultimately leads to better learning outcomes, better metacognitive assessment of cognitive load [24]. Questions activate indirectly also meta-cognitive processes so that students become aware of how well they master the subject matter and whether they need to study it further. When a student answers a question correctly, it will strengthen his knowledge, and if a student answers incorrectly, the failure can educate students and encourage teachers to re-teach existing concepts [18].

The students' questioning ability must be continuously improved. Developing and communicating evidence-based explanations such as asking or answering questions is

considered an important skill in 21st century learning. These skills are at the core of the scientific argumentation process. Therefore, lecturers must adopt a student-centered pedagogy that fosters understanding and argumentation skills [25]. Knowledge is not information but a series of activities i.e. activities cannot be "stored and retrieved" but can only be developed, carried out, and carried out again [16].

4 Conclusion

The questioning ability of biology education students at University of Bengkulu is still classified as *Low Order Thinking Skill* (LOTS). The quality of students' questions was dominated by questions at the cognitive level C1–C3. Therefore, the students' questioning ability must be improved. The assistance of the lecturer as a facilitator and director for the students to ask questions with good quality definitely can help the high interaction between students and lecturers and students with other students. This is expected to have an impact on the level of thinking and better student learning outcomes.

References

1. J. M. Tigert, G. Fotouhi, and S. Kirschbaum, "An Investigation of Museum Educators' Questioning During Field Trips," *Learn. Cult. Soc. Interact.*, vol. 31, no. A, p. 100571, 2021, https://doi.org/10.1016/j.lcsi.2021.100571.
2. A. Ziyaeemehr, "Use of Questioning Techniques and the Cognitive Thinking Processes Involved in Student-Lecturer Interactions," *Int. J. Humanit. Cult. Stud.*, vol. 3, no. 1, pp. 1427–1442, 2016.
3. L. Montello and W. Bonnel, "The Versatile Question: Diverse Uses of Questioning in Online and Traditional Learning," *Teach. Learn. Nurs.*, vol. 4, no. 3, pp. 71–75, 2009, https://doi.org/10.1016/j.teln.2008.11.003.
4. F. Ramadhan, S. Mahanal, and S. Zubaidah, "Kemampuan Bertanya Siswa Kelas X SMA Swasta Kota Batu Pada Pelajaran Biologi (Asking Ability of Class X Students of Batu City Private High School in Biology Lessons)," *BIOEDUKASI (Jurnal Pendidik. Biol.*, vol. 8, no. 1, pp. 11–15, 2017, https://doi.org/10.24127/bioedukasi.v8i1.831.
5. A. R. Zolfaghari, D. Fathi, and M. Hashemi, "The Role of Creative Questioning in the Process of Learning and Teaching," *Procedia - Soc. Behav. Sci.*, vol. 30, pp. 2079–2082, 2011, https://doi.org/10.1016/j.sbspro.2011.10.404.
6. R. M. Gillies, K. Nichols, G. Burgh, and M. Haynes, "The Effects of Two Strategic and Meta-Cognitive Questioning Approaches on Children's Explanatory Behaviour, Problem-Solving, And Learning During Cooperative, Inquiry-Based Science," *Int. J. Educ. Res.*, vol. 53, no. 1, pp. 93–106, 2012, https://doi.org/10.1016/j.ijer.2012.02.003.
7. T. Yan, Z. Wang, C. Lio, W. Xu, and Wan Li, "Effects of The Morphological Characteristics of Plants on Rainfall Interception and Kinetic Energy," *J. Hydrol.*, vol. 592, no. 125807, 2021.
8. G. Tjitrosoepomo, *Morfologi Tumbuhan.* Yogyakarta: Gajah Mada University Press, 2012.
9. V. G. Smith and A. Szymanski, "Critical Thinking : More Than Test Scores," *NCPEA Int. J. Educ. Leadersh. Prep.*, vol. 8, no. 2, pp. 16–26, 2013.
10. F. Paetzel and R. Sausgruber, "Cognitive Ability and In-Group Bias: An Experimental Study," *J. Public Econ.*, vol. 167, pp. 280–292, 2018, https://doi.org/10.1016/j.jpubeco.2018.04.006.
11. A. Bahri and A. D. Corebima, "The contribution of learning motivation and metacognitive Skill on Cognitive Learning Outcome of Students Within Different Learning Strategies," *J. Balt. Sci. Educ.*, vol. 14, no. 4, pp. 487–500, 2015, https://doi.org/10.33225/jbse/15.14.487.

12. E. Demİrhan, I. Onder, and S. Besoluk, "Brain Based Biology Teaching : Effects on Cognitive and Affective Features and Opinions of Science Teacher Trainees," *J. Turkish Sci. Educ.*, vol. 11, no. 3, pp. 65–78, 2014, https://doi.org/10.12973/tused.10119a.
13. C. Lwande, L. Muchemi, and R. Oboko, "Identifying Learning Styles and Cognitive Traits in a Learning Management System," *Heliyon*, vol. 7, no. 8, pp. 1–9, 2021, https://doi.org/10.1016/j.heliyon.2021.e07701.
14. D. Wahyudi, "the Use of Questioning Technique To Enhance Students' Speaking Ability," *Indones. J. Integr. English Lang. Teach.*, vol. 3, no. 1, pp. 93–118, 2017, https://doi.org/10.24014/ijielt.v3i1.3971.
15. D. R. Krathwohl, "A Revision of Bloom ' s Taxonomy :," *Theory Pract.*, vol. 41, no. 4, pp. 212–219, 2002.
16. I. M. Arievitch, "The Vision of Developmental Teaching and Learning and Bloom's Taxonomy of Educational Objectives," *Learn. Cult. Soc. Interact.*, vol. 25, no. 100274, pp. 1–6, 2020, https://doi.org/10.1016/j.lcsi.2019.01.007.
17. H. Hendriana, E. Eti Rohaeti, and W. Hidayat, "Metaphorical Thinking Learning and Junior High School Teachers' Mathematical Questioning Ability," *J. Math. Educ.*, vol. 8, no. 1, pp. 55–64, 2017, https://doi.org/10.22342/jme.8.1.3614.55-64.
18. J. B. Hill, "Questioning Techniques: A Study of Instructional Practice," *Peabody J. Educ.*, vol. 91, no. 5, pp. 660–671, 2016, https://doi.org/10.1080/0161956X.2016.1227190.
19. H. Van Der Meij and J. T. Dillon, "Adaptive Student Questioning and Students' Verbal Ability," *J. Exp. Educ.*, vol. 62, no. 4, pp. 277–290, 2010, https://doi.org/10.1080/00220973.1994.9944135.
20. T. L. Mitee and G. N. Obaitan, "Effect of Mastery Learning on Senior Secondary School Students' Cognitive Learning Outcome in Quantitative Chemistry," *J. Educ. Pract.*, vol. 6, no. 5, pp. 34–38, 2015, [Online]. Available: http://search.proquest.com.ezp.lib.unimelb.edu.au/docview/1773220132?accountid=12372.
21. M. A. Aripin, R. Hamzah, P. Setya, M. H. M. Hisham, and M. I. Mohd Ishar, "Unveiling a new taxonomy in education field," *Int. J. Eval. Res. Educ.*, vol. 9, no. 3, pp. 524–530, 2020, https://doi.org/10.11591/ijere.v9i3.20458.
22. D. Smith *et al.*, "Role of Cognitive Prompts in Video Caregiving Training for Older Adults: Optimizing Deep and Surface Learning," *Educ. Gerontol.*, vol. 45, no. 1, pp. 45–56, 2019, https://doi.org/10.1080/03601277.2019.1580442.
23. G. P. Risner, "Cognitive Levels of Questioning Demonstrated by Test Items That Accompany Selected Fifth-Grade Science Textbooks," 1987.
24. U. İlİc and Y. Akbulut, "Effect of Disfluency on Learning Outcomes, Metacognitive Judgments and Cognitive Load in Computer Assisted Learning Environments," *Comput. Human Behav.*, vol. 99, no. June, pp. 310–321, 2019, https://doi.org/10.1016/j.chb.2019.06.001.
25. R. P. Antonio and M. S. Prudente, "Metacognitive Argument-Driven Inquiry in Teaching Antimicrobial Resistance: Effects on Students' Conceptual Understanding and Argumentation Skills," *J. Turkish Sci. Educ.*, vol. 18, no. 2, pp. 192–217, 2021, https://doi.org/10.36681/tused.2021.60.