

**HIGHER ORDER THINKING AND CRITICAL THINKING SKILLS OF STUDENTS  
ON PLANT TISSUE**

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**ABSTRACT**

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This research aims to know students' higher order thinking and critical thinking skills on plant tissue topics. The research was conducted in senior high school grade XI Science of SMAN 2 Kisaran, and the sample was taken by random sampling. The kind of this research is descriptive quantitative. The number of each test, higher-order thinking skills test, and a critical thinking skills test are 30 items. The research results are that the students' higher-order thinking skills of plant tissue topic are at moderate categories. The achievement of students' higher-order thinking skills is at a good level because the value of the higher-order thinking achievement of students in class XI is about 60-69%. The student's critical thinking skills of plant tissue topic is still in less categories. Students' critical thinking skills in this school are at less level because the value of students' higher-order thinking achievement in class XI is about 50-59%.

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## INTRODUCTION

Education in Indonesia has always undergone improvements which in the end produce a quality education product or result. Various efforts have been made to improve the quality of existing education and create a reliable future generation capable of facing various life challenges. These improvements include the improvements in the education system or things directly related to learning practices. The Indonesian government designed the policy on the 2013 curriculum through Ministerial Regulation No. 22 of 2016 concerning process standards. It is clear that as a curriculum improvement plan, it is expected that students can develop themselves in thinking. Students are required to have lower-order thinking skills (LOTS) and higher-order thinking skills (HOTS). According to [Anderson and Karthwol \(2001\)](#), states that indicators for measuring HOTS include analyzing (C4), evaluating (C5), and creating (C6) ([Nuragni, 2018](#)).

According to [Retnawati et al \(2018\)](#), HOTS is most easily identified through Bloom's taxonomy. With the revised Bloom's taxonomy proposed by [Anderson and Karthwol \(2001\)](#), HOTS indicators can be easily formulated in learning. In the revised Bloom's taxonomy, the cognitive process dimension is seen as a verb that describes a particular process, while the knowledge dimension is seen as a noun that functions as the object of the process carried out. The existence of these two components (verb and noun).

Critical thinking is thinking that examines, connects, and evaluates all aspects of a situation or problem, including its performance gathering, organizing, remembering, and analyzing information (Helmawati, 2019). Critical thinking is thinking rationally and reflectively ([Ennis, 2011](#)). Learning should be directed so that students gain independence, higher-order thinking, and critical thinking skills ([Arends and Kilcher, 2010](#)); [Bookhart, \(2010\)](#); [Conklin, \(2012\)](#); [Halpern, \(2014\)](#).

According to [Nugroho \(2018\)](#); [Sani \(2019\)](#), critical thinking is convergent thinking, whereas creative thinking is divergent thinking. Convergent thinking is a process of processing information from various points of view to get conclusions. In contrast, divergent thinking is developing the mind from a piece of information into various ideas or points of view. Individuals who are able to think creatively will be able to produce new concepts, ideas, or products that are different from existing concepts, ideas, or products. Someone in solving a complex problem needs to think critically and think creatively (higher-order thinking skills).

Table 1. Achievement of Higher Order Thinking Skills of Students

## METHOD

The researcher uses a descriptive research method followed by a quantitative research approach that analyses the students' ability to answer higher-order thinking skills and critical thinking questions on plant tissue topics in grade XI science SMA Negeri 2 Kisaran academic year 2019/2020. This research is descriptive because it is not necessary to control treatment or is not intended to test the hypothesis.

This research is designed by giving a multiple-choice test to measure the students' skills in answering the higher-order thinking and critical thinking questions to all of the sample classes, namely XI MIPA 1 and XI MIPA 2. Students' answers results are analyzed to determine their skills in answering higher-order thinking and critical thinking questions.

This research was conducted in SMA Negeri 2 Kisaran, during August – October 2019. The sample in this research is chosen using random sampling because there were no strata of the population. Random sampling techniques can be done because the population is homogeneous ([Pohan and Syahwin, 2017](#)). The sample is used to select two classes out of population for the research, and the samples are XI MIPA 1 and XI MIPA 2.

The instrument used in this research is multiple-choice tests based on revised Bloom's Taxonomy in higher-order thinking and critical thinking cognitive level. For higher-order thinking skills, questions given in this research consist of 15 items covering levels C4, C5, and C6 according to Bloom's taxonomy. Critical thinking skills are completed by giving multiple-choice questions consisting of 15 items covering levels C4 and C5 according to Bloom's Taxonomy.

## RESULTS AND DISCUSSION

Four questions include to C4 cognitive dimension, six questions include the C5 cognitive dimension, and six questions include the C6 cognitive dimension. The following is Table 1. shows the achievement of higher-order thinking skills for students in grade XI science SMAN 2 Kisaran.

Class	Percentage Value (PV) of Higher Order Thinking Skills of Students	
XI MIPA 1	PV Average (%)	71.84
XI MIPA 2	PV Average (%)	59.62
<b>Average of PV (%)</b>		<b>65.73</b>

From Table 1 above, it can be seen that the average percentage of students with higher-order thinking skills at SMAN 2 Kisaran is 65.73%. The value obtained is in the "enough category" because the range is between 60-69%. Class XI MIPA 1 gets a higher score of higher thinking skills than class XI MIPA 2. From the percent value of each class, class XI MIPA 1 obtained a higher thinking skills achievement, 71.84%. Class XI MIPA

2 obtained a higher-order thinking ability achievement of 59.62%. HOTS ability of students from XI MIPA 1 higher than students from XI MIPA 2.

Eight questions include C4 cognitive level and seven questions that include C5 cognitive level. The following is Table 2 that shows the achievement of critical thinking skills students in grade XI science SMAN 2 Kisaran.

Table 2. Achievement of Critical Thinking Skills Students

Class	Percentage Value (PV) of Critical Thinking Skills	
XI MIPA 1	PV Average (%)	61.84
XI MIPA 2	PV Average (%)	49.62
<b>Average of PV (%)</b>		<b>55.73</b>

From Table 2 above, it can be seen that the average percentage of students' critical thinking skills at SMAN 2 Kisaran is 55.73%. The value obtained is in the "less category" because the range is between 50-69%. Class XI MIPA 1 gets a higher score of critical thinking skills than class XI MIPA 2. From the percent value of each class, class XI MIPA 1 obtained a critical thinking skills achievement of 61.84%. Class XI MIPA 2 obtained a higher-order thinking ability achievement of 55.73%.

students have less critical thinking skills in plant tissue topics. For XI MIPA 1, students seem to have better critical thinking skills than XI MIPA 2. It can be seen almost all of the students got more scores. From the result, it can be found that some questions are difficult for the students to be answered. There are three ranges of difficult questions, namely question number 1(C4), 6(C4), and 15(C4). In line with [Imi and Lagiomo's \(2019\)](#) research results, the student has difficulty answering the HOTS level. Likewise, based on the results of research by [Baylon \(2014\)](#); [Helnawati \(2019\)](#), higher-order and critical thinking can increase motivation and thought control for students.

Overall, less than half of the higher-order thinking questions were answered correctly by students in both XI MIPA 1 and XI MIPA 2. It means that the students have less category in answering higher-order thinking skills questions in plant tissue topic. For XI MIPA 1, students seem to have better higher-order thinking skills than XI MIPA 2. It can be seen almost all of the students get more scores. From the result, it can be found that some questions are difficult for the students to be answered. There are three ranges of difficult questions, namely question number 8 (C5), 10 (C6), and 14 (C6). When compared with the research results of [Susilo \(2010\)](#) that students need to be trained to think at high levels and critically, likewise [Kartimi and Liliasari \(2012\)](#) stated that evaluation needs to be done with high-order thinking and critical thinking skills.

The students' Higher Order Thinking and Critical Thinking Skills based on the cognitive aspect of revised Bloom's Taxonomy, in analyzing aspect (C4), that the student breaks learned information into its part to best understand that information in an attempt to identify evidence for a conclusion ([Anderson and Krathwohl, 2001](#)). The students' answers indicate that students can be answering higher-order thinking and critical thinking skills questions are 76.66% and 69.11% averaged 72.88% of students who can answer the higher-order thinking and critical thinking skills questions. Some of the students have difficulty analyzing characteristics (location and structure) and differentiating various tissues' functions in plants. For example in higher order thinking question number 1 and critical thinking question

Overall, less than half of the critical thinking questions were answered correctly by students in both XI MIPA 1 and XI MIPA 2. It means that the

number higher-order into the second indicator (distinguishing the characteristics of all permanent tissue), many students have difficulty in showing the characteristics of the meristem tissue from several statements. The average score of 72.88% indicates the 'enough category' of students' achievement average analyzing (C4) cognitive dimension. Judging from these results, that the learning objectives have not been achieved. This is in line with [Heong et al \(2011\)](#); [Gais and Afriansyah \(2017\)](#), that the higher-order thinking and critical thinking skills achieved by students show the effectiveness of achieving learning objectives.

In evaluating aspect, the student makes decisions based on in-depth reflection, criticism, and assessment. At this level, the analysis refers to breaking or rearranging the information that they already get to become clear elements. The ability included analyzing elements (parts of information), analyzing relations, and analyzing the organization ([Anderson and Krathwohl, 2001](#)). The students' answers indicate that students can answer higher-order thinking and critical thinking skills questions are 68.3% and 61.72% averaged 65.01% of students who can answer higher-order thinking and critical thinking skills questions. Many students experience difficulties in determining the correct statement from several statements relating to plant tissue. For example, in higher-order thinking question number 8 and critical thinking question number 12, which belongs to the third indicator (comparing the cell structure of plant tissue on the figure), many students have difficulty showing plant tissue structure from several figures presented. The average score of 65.01% indicates the 'less category' of students' achievement in evaluating (C5) cognitive dimension. Even though the results are low, students' higher-order thinking and critical thinking skills need to be introduced. This is in line with the opinion of [Hugerat and Najj \(2014\)](#); [Erfan and Ratu \(2018\)](#), which states that higher-order thinking skills and critical thinking skills for students can be exploited in a different context than C5 level.

The creating aspect or the highest level of the cognitive domain is the creating level, where the student creates new ideas and information using what has been previously learned ([Anderson and Krathwohl, 2001](#)). The students' answers indicate that students have the ability to answer higher-order thinking is 52.77%. Many students experience difficulties in expressing and developing ideas, solutions, and methods in the material discussed. For example, in question number 10, many students have difficulty explaining the totipotency and plant tissue culture

technique. The same thing is found in question number 9. Many students have difficulty explaining the differences between meristem and permanent tissue. The students did not answer the question correctly in this cognitive aspect because they have difficulty creating a new idea to hypothesize and develop an experimental design, but they seldom do experiments for studying this topic, and of course, it makes most of the students failed to answer these questions. The score of 52.77% indicates the 'less category' of students' achievement in creating (C6) cognitive dimension. This C6 level of thinking ability is still low. In line with the results of [Karli \(2012\)](#); [Cimer \(2012\)](#), which states creative thinking skills are still considered challenging because they are not used to thinking holistically. Likewise, this study's results align with [Utami's \(2016\)](#) research, which states that the students have difficulty in higher-order thinking and creative thinking on plant tissue material.

## CONCLUSION

Based on the research, it can be concluded that the value of the higher-order thinking achievement of students in grade XI Science SMAN 2 Kisaran is in the "moderate" category." While the value of the critical thinking achievement of students is in the "less category".

## REFERENCES

- Anderson, L. W. & Krathwohl. (2001). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. New York: Longman.
- Arends, R. I. & Kilcher, A. (2010). *Teaching for Student Learning Becoming an Accomplished Teacher*. New York: Routledge.
- Baylon, E. M. (2014). Effects of Classroom Assessment on The Critical Thinking and Academic Performance of Students. *Asia Pacific Journal of Multidisciplinary Research*, 2(1), 205-208.
- Bookhart, S. M. (2010). *How to Assess Higher Order Thinking Skills in Your Classroom*. Alexandria: VA, ASCD.
- Cimer, A. (2012). What Makes Biology Learning Difficult and Effective: Students' Views. *Educational Research and Review*, 7(3), 61-71.
- Conklin, W. (2012). *Higher-Order Thinking Skills for Develop 21<sup>st</sup> Century Industry*. Huntington Beach: Shell Educational Publishing, Inc.

- Ennis, R. (2011). *The Nature of Critical Thinking: An Outline of Critical Thinking Dispositions and Abilities*. University of Illinois: Chicago.
- Erfan, M. & Ratu, T. (2018). Pencapaian HOTS (Higher Order Thinking Skills) Mahasiswa Program Studi Pendidikan Fisika FKIP Universitas Samawa. *Jurnal Pendidikan Fisika dan Teknologi*, 4(2), 208-212.
- Gais, Z. & Afriansyah, E. A., (2017), Analisis Kemampuan Siswa dalam Menyelesaikan Soal High Order Thinking Ditinjau dari Kemampuan Awal Matematis Siswa. *Jurnal Mosharafa*, 6(2): 255-266.
- Halpern, D. F. (2014). *Thought and Knowledge: An Introduction to Critical Thinking*. New York: Taylor and Francis.
- Helnawati. (2019). Pembelajaran dan Penilaian Berbasis HOTS (Higher Order Thinking Skills). Bandung: Remaja Rosdakarya.
- Heong, Y. M., Othman, W. B., Yunos, J. B. M., Kiong, T. T., Hassan, R. B., & Mohaffyza, M. (2011). The Level of Marzano Higher Order Thinking Skills among Technical Education Students. *International Journal of Social and Humanity*, 1(2), 121-125.
- Hugerat, M. & Naji, K. (2014). Improving Higher Order Thinking Skills among Freshman by Teaching Science through Inquiry. *UERASIA Journal of Mathematics Science and Technology Education*, 10(5), 447-454.
- Ilmi, M. & Lagiomo, L. (2019). Pengaruh Model Problem Based Learning Terhadap Hasil Belajar Kognitif dan Berpikir Kritis Siswa Kelas X MIA SMAN 2 Kandungan Pada Konsep Ekosistem. *Jurnal Pendidikan Hayati*, 5(2), 39-51.
- Karli, H. (2012). Model Pembelajaran untuk Mengembangkan Keterampilan Berpikir. *Jurnal Pendidikan Penabur*, 11(2), 56-66.
- Kartimi & Liliarsari. (2012). Pengembangan Alat Ukur Berpikir Kritis pada Konsep Termokimia untuk SMA Peringkat Atas dan Menengah. *Jurnal Pendidikan IPA Indonesia*. 1(2): 21-26.
- Nugroho, R. A. (2018). *HOTS: Higher Order Thinking Skills*. Jakarta: Gramedia Widiasarana Indonesia.
- Nuragni, W. T. (2018). *Analisis Kemampuan Siswa dalam Menyelesaikan Soal Tipe Higher Order Thinking pada Pokok Bahasan Pola Bilangan di Kalangan Siswa Kelas VIII E SMP N 5 Yogyakarta Tahun Ajaran 2018/2019*. Yogyakarta: Jurusan Matematika, Universitas Sanata Dharma.
- Pohan, L. A., & Syahwin. (2017). Identification of Acid-Based Concept Understanding Using the Assessment of A Two Tier Multiple Choice Diagnostic Instrument. *Multidisciplinary Research (ICMR), jurnal.unsiyah.ac.id.AICS-Social/article/download*.
- Retnawati, H., Djidu, H., Kartianom., Apino, E., & Anazifa, R. D. (2018). Teachers' Knowledge about Higher-Order Thinking Skills and It's Learning Strategy. *Educational Journal*, 76(2), 2015-230.
- Sani, R. (2019). *Pembelajaran Berbasis HOTS (Higher Order Thinking Skills)*. Tangerang: Tira Smart.
- Susilo, A. B. (2012). Pengembangan Model Pembelajaran IPA Berbasis Masalah untuk Meningkatkan Motivasi Belajar dan Berpikir Kritis Siswa SMP. *Unnes Science Education Journal*. 1(1), 12-20.
- Utami, M. (2016). Identifikasi Kesulitan Belajar Materi Struktur-Fungsi Jaringan Tumbuhan pada Siswa SMA Negeri 3 Klaten Kelas XI Tahun Ajaran 2015/2016. *Jurnal Pendidikan Biologi*, 5 (7), 19-26.