



Excel in Critical and Creative Thinking in Object-Oriented Programming

Fitria Nur Hasanah¹(✉), Rahmania Sri Untari¹, Shofiyah Al Idrus²,
and Akhmedova Mehrinigor Bahodirovna³

¹ Universitas Muhammadiyah Sidaorjo, Sidaorjo, Indonesia
fitrianh@umsida.ac.id

² State University of Malang, Malang, Indonesia

³ Bukhara State University, Bukhara, Uzbekistan

Abstract. The aim of this qualitative research study was to analyze the higher order thinking skills (HOTS) of students enrolled in object-oriented programming courses. The study involved five third-semester students, who were evaluated based on their performance in a test consisting of descriptive questions and interviews. The results revealed that four out of the five students had scored high in the HOTS categories of analyzing, evaluating, and creating. The fifth student's score was in the moderate category. The factors that influenced the test scores were the students' ability to answer the questions properly, solve the programming questions given, and analyze program coding errors. The study implies that it is important for students to develop their HOTS in order to excel in object-oriented programming courses, and that educators should incorporate strategies that promote critical and creative thinking in their teaching methods.

Keywords: Higher order thinking skills · Object-oriented programming · Critical thinking · Creative thinking

1 Introduction

Higher education is one of the important educational facilities in the process of transferring values and knowledge that takes place between educators, namely lecturers and students as students, so that from this process it is hoped that it will be able to produce superior individuals and be able to make a significant contribution to the progress of the nation. And country. One of the objectives of Higher Education According to Government Regulation No. 60 of 1999 concerning Higher Education, Article 2, is to prepare students to become members of society who have academic and/or professional abilities who can apply, develop and/or enrich the repertoire of science, technology and/or the arts. In developing knowledge, students are expected to have the ability to think critically, one of which is through problem solving skills. Problem solving abilities certainly play an important role in the learning process, because problem solving abilities are fundamental abilities. Problem solving can also be said as a learning method that can train and improve problem solving abilities in learning activities [1].

Students are expected to be able to respond to various changes quickly. Because it requires flexible intellectual skills, especially in analyzing information and integrating various sources of knowledge to solve problems. Critical thinking can also improve verbal and analytical skills. Through clear and systematic thinking can improve the way to express ideas, useful in learning how to analyze the structure of text logically, and improve the ability to understand problems.

Critical thinking can be achieved if someone has higher order thinking skills (HOTS). Pratiwi explained that HOTS is a high level of understanding of students in solving problems. High in this case, namely students are required to think critically by analyzing questions and looking for answers independently. Referring to Anderson's version of Blooms taxonomy included in the HOT questions are the question categories C4 (analyze), C5 (assess), and C6 (create)(2) [2].

One of the basic programming courses that Information Technology Education students must master is the Object Oriented Programming (OOP) course. OOP is programming that uses classes and objects that teach not only how students can write program code but also a perspective in analyzing systems and problems that occur in programming [3]. When compiling and translating programming scripts students are required to be able to think critically and creatively in completing program scripts.

This critical thinking process is in line with HOTS. HOTS or higher-order thinking skills are part of the revised Bloom's taxonomy in the form of operational verbs consisting of analyze (C4), evaluate (C5) and create (C6) which can be used in the preparation of questions (Iskandar & Senam, 2015). Therefore, when students are able to solve HOTS questions, they can be said to have the ability to think critically. HOTS questions in the context of the assessment measure the ability to: 1) transfer one concept to another, 2) process and apply information, 3) seek connections from various different types of information, 4) use information to solve problems, and 5) analyze ideas and information critically. HOTS will develop if individuals face unknown problems, challenging questions, or face uncertainty [4]. Brookhart stated that HOTS occurs when students do at least one of the following: (a) analyze, evaluate and create (b) reason logically, (c) make decisions and think critically, (d) solve problems, and (f) do creativity and creative thinking [5].

Based on the observations of researchers in the OOP course, students still experience difficulties in analyzing program scripts on inheritance material. The habit that students do in working on existing projects is not just memorizing and restating known information but also connecting, manipulating, and transforming the knowledge and experience they already have [6]. So based on this background, this study aims to analyze the HOTS abilities of PTI Umsida students in the OOP course.

2 Method

The type of research used is descriptive research with a quantitative approach. Qualitative research is a scientific research, which aims to understand phenomena about what is experienced by research subjects such as behavior, perceptions, motivations, actions, etc. holistically and by means of descriptions in the form of words in a special natural context with using a variety of scientific methods [7]. The qualitative approach used is used to describe the analysis of students' HOTS abilities in OOP courses on inheritance.

Table 1. Categories of HOTS ability levels

Component	HOTS
> 87	Very high
75–86	Tall
63–74	Currently
50–62	Low
< 50	Very low

The research subjects were 5 semester 3 PTI students who were currently taking OOP courses. Data collection techniques used are HOTS test sheets and interviews. The test sheet is in the form of HOTS questions which consist of description questions. While the interview guideline was used to gather information at the HOTS problem completion stage conducted by the research subject, the interviews conducted were open interviews so that questions could develop during the interview process. To ensure the validity of the data, triangulation was carried out. Interviews were conducted with students regarding problem-solving skills in inheritance material.

The development of the HOTS instrument in research refers to what was put forward by Bloom's taxonomy which includes analyze, evaluate, and create, where analyze includes analyzing incoming information and structuring information and identifying or formulating questions; evaluate includes, making hypotheses, criticizing and testing, accepting or rejecting a statement based on predetermined criteria; and create include, devising a way to solve the problem.

The data collection procedure began with giving HOTS test questions to 5 research subject students to be corrected and assessed by the researcher. Correction results are then grouped from the highest value to the lowest value. From the results of these values, interviews were then carried out in accordance with using the student's answers as a reference [8].

3 Results

The results of research that has been carried out in OOP courses obtained from data described based on HOTS indicators, namely analyzing, evaluating, and creating are shown in Table 2.

Based on Table 1, it is found that the HOTS ability with an average of 78.8 is in the high category. Students' HOTS scores based on test results showed that 4 students scored in the high category and 1 student scored in the moderate category. HOTS indicators are aspects of analyzing, evaluating, and creating. The factors that influence the results of the essay test are, (1) students are able to answer the questions given properly, (2) students are able to solve the programming questions given, (3) students are able to analyze program coding errors.

60% of students get scores above the average and 40% get scores below the average. This shows that students are able to solve OOP questions based on HOTS indicators. This

Table 2. PTI Student HOTS Ability Data

Component	HOTS
Subject	5
Highest score	84
Lowest score	72
Mean	78.8
Median	80
Stdev	4.30

is in accordance with the opinion of Lewis (2011) which states that high-level thinking must be mastered by students in order to be able to analyze, collect evidence, and build arguments and create ideas (9). Students are able to answer correctly on the problem of analyzing as many as 4 students. This shows that students can analyze questions related to coding in OOP. With HOTS abilities, students can develop new insights, communicate well, and be able to manage information effectively (10). Students who correctly complete the category questions evaluate as many as 3 people, the evaluation questions that are able to be completed by students are evaluating errors that occur in OOP scripts. There were 3 students who were able to answer correctly the questions about create.

4 Conclusion

Based on the results of the research that has been done, the Higher Order Thinking skills of PTI students in OOP courses are in the high category. The factors that influence the results of the essay test are, (1) students are able to answer the questions given properly, (2) students are able to solve the programming questions given, (3) students are able to analyze program coding errors.

References

1. Mariam S, Nurmala N, Nurdianti D, Rustyani N, Desi A, Hidayat W. Analisis Kemampuan Pemecahan Masalah Matematis Siswa MTsN Dengan Menggunakan Metode Open Ended Di Bandung Barat. *J Cendekia J Pendidik Mat.* 2019;3(1):178–86.
2. Siti Zubaidah. Berfikir Kritis : Kemampuan Berpikir Tingkat Tinggi Yang dapat Dikembangkan Melalui Pembelajaran Sains. *Semin Nas Sains 2010 dengan Tema “Optimalisasi Sains untuk Memberdayakan Manusia.”* 2010;16(January 2010):1–14.
3. Wibowo K. Analisa Konsep Object Oriented Programming Pada Bahasa Pemrograman Php. *Khatulistiwa Inform.* 2012;3(2):151–9.
4. Ismayani RM, Aditya P, Sary S. Pelatihan penyusunan soal berbasis HOTS bagi guru bahasa Indonesia tingkat SMP Se-Kabupaten Subang. *Abdimas Siliwangi.* 2020;3(1):173–85.
5. Brookhart S. *How To Asses Higher Order Thingking Skill In Your Classroom.* Alexandria: ASCD; 2010.

6. Ngazizah N, Linda RFC, Kurniasari SG, Fakhrina A, Widanti W. Analisis Kemampuan Hots Melalui Pjbl Dimasa Pandemi Covid-19 Mahasiswa Semester 2 Pada Mata Kuliah Ipa Lanjut. *J IPA Terpadu*. 2020;4(1):90–9.
7. Moleong LJ. *Metodologi Penelitian Kualitatif*. Bandung: PT. Remaja Rosdakarya.; 2008.
8. Purwanto N. *Prinsip-prinsip dan Teknik Evaluasi Pengajaran*. PT. Remaja Rosdakarya.; 2012.
9. Lewis, A. & S. Defining Higher Order Thinking. *Theory Into Practice*. 32(3), 131–137. <https://doi.org/10.1080/00405849309543588>. 2011.
10. Tan, S.Y. & Halili S. Effective Teaching of Higher-Order Thinking (HOT) in Education. *Online J Distance Educ Learn*. 2015;3(2):41–7.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

