Development of Higher Order Thinking Skills Assessment Based on Scientific Article Reviews

Rahma Widiantie*, Handayani, Ina Setiawati, Ashhafa Roqiqulqolby

Biology Education Study Program, Universitas Kuningan, Kuningan, Indonesia

{rahma.widiantie@uniku.ac.id}

Abstract. Higher order thinking skills are essential skills that must be possessed by students where the assessment tool developed must also be adjusted to the competencies to be achieved, but lecturers are still having difficulties due to the lack of authentic assessment alternatives that assess these skills. There are several authentic forms of assessment to assess higher order thinking skills, namely the assessment of written works and product project including of scientific article reviews. The purpose of this study is to develop an authentic assessment of higher order thinking skills based on a scientific article review strategy. This research is a research and development (R&D). The results of expert validation are construct validation 3.4 (valid) and content validation 3.4 (valid), meaning that the assessment developed is valid. The results of the small-scale trial show that the assessment tool is valid and reliable in the high category. Profile of students' higher order thinking skills with superior criteria in analyzing, evaluating and creating skills. Where the highest score is on the analytical skill and the lowest is the creative skill. The conclusion of this study is that the assessment developed is valid and reliable for use in several courses that facilitate higher order thinking skills by applying the strategy of reviewing scientific articles.

Keywords: HOTS; Scientific Literature Review; Skills

1 Introduction

Higher Order Thinking Skills (HOTS) is a term that is increasingly being mentioned and discussed in the 21st century education era because it is considered one of the 21st century skills. 21st century learning emphasizes the ability of students to find out from various sources, formulate problems , analytical thinking, cooperation and collaboration in solving problems [1] . The 21st century learning frameworks include the following: (a) critical thinking and problem solving skills; (b) communication and collaboration skills; (c) the ability to create and renew; (d) information and communication technology literacy; (e) contextual learning ability. To facilitate these abilities, learning must familiarize students to practice higher order thinking skills.

Higher-order thinking skills are needed to deal with the demands of changing times. The concept of HOTS is described in the discussion of the cognitive domain, which is a domain that involves knowledge and intellectual skills. Bloom describes the level of cognitive processes from the simplest to the complex level, known as the level of cognitive skills. The level categories have been revised and organized into 6 levels, namely Remembering, Understanding, Applying, Analyzing, Evaluating and Creating, also known as C1 to C6.

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Based on the level of intellectual skills, levels C4 (Analyze), C5 (Evaluate) and C6 (Create) are categorized as high-level thinking skills or HOTS [2]. HOTS is indispensable in preparing students to face global challenges. To see the achievement of higher thinking skills, it is necessary to conduct an assessment using authentic assessments that measure these skills [3].

Learning will be meaningful if students are invited to think at a higher level. The success of mastery of concepts will be obtained when students are able and accustomed to high-level thinking, where students not only remember and understand concepts but are able to analyze, evaluate and create a concept. The concepts that have been understood can be embedded in students' memories for a long time, so it is very important that students have higher-order thinking skills [4] . HOTS is very important to be applied and developed in learning. If students have high-order thinking skills, then in learning they will be able to use problem solving methods properly, precisely and confidently. When learning activities focus on the target of developing HOTS, it will greatly affect learning activities that are more effective and students become more trained [5] .

Assessment is a process of collecting data that can show the progress of students' learning, the assessment that is used should be an authentic assessment which can clearly and clearly describe the thinking processes of students. [6] states that authentic assessment is an assessment carried out through presentation or appearance by students in the form of working on certain tasks or activities that have educational meaning. Authentic assessment provides opportunities for students to complete authentic assignments that are interesting, useful and relevant to students' lives. Based on some authentic research, an assessment to assess HOTS can be in the form of students' ability to ask questions and have opinions during the learning process, it can also be seen through students' writings or representations in the form of images, media and other products produced by students. The HOTS assessment that needs to be developed is not an assessment that only plays a role in measuring the level of student achievement, but an assessment that will train students to think critically and is equipped with feedback that will provide information to students about weaknesses that need to be improved.

The assessment that will be developed in this research is to assess students' skills in analyzing relevant research journals including background, research methods, results and discussion; skills in evaluating national and international journals that are relevant to the themes and issues studied; skills in creating research proposal designs based on the results of the journal's analysis. The results of research proposal designs made by students can provide an overview of how the level of students' higher-order thinking skills and can be used as a reference in writing the next thesis. The activity of analyzing scientific articles is a form of learning to study the development of a theory or a science. By analyzing scientific articles, students will get information that will increase their knowledge about a science being studied [7] .

2 Methodology

The research method used in this study is research and development (Research & Development) which consists of two main objectives, namely developing products and testing the effectiveness of products in achieving goals [8]. The product developed is an assessment of higher order thinking skills based on a review of scientific articles. The subjects used in the small-scale trial were 27 students who took the Biology Education Seminar course. Taking the subject by using purposive sampling technique. Validation of expert users as many as 3 people

who are experts in the field of evaluation tools and users of the assessment. The criteria for the success of the product developed are based on 2 criteria, namely the validity of the expert must be valid, and the second is that the assessment has high validity and reliability.

3 Result and Discussion

The research results begin with the results of expert and user validation. The results of the expert validation of the assessment of higher order thinking skills based on a review of scientific articles were valid with a slight revision to the grammar used as material for improving the assessment tool and then a small-scale trial was carried out on 27 students.The validation results are presented in Table 1.

Table 1. The expert validation result

No.	Validasi	Rata-rata skor	Keterangan
1	Construct validation	3,4	Valid
2	Content validation	3,4	Valid

The assessment of higher-order thinking skills developed consists of analytical skills which include: analyzing the background of the research problem, analyzing the suitability of the research methodology and the problems studied, analyzing theoretical studies relevant to research journals, and analyzing the suitability of research results with problems. Evaluation skills which include: presenting their own views on research journals with valid arguments, and providing an assessment of the consistency of research journals, while creative skills include: determining the theme of the proposal design, compiling research proposals adapted to the results of journal analysis, accuracy in compiling theoretical studies, systematic accuracy preparation of research proposals, and the correct use of writing and language. The results of the small-scale assessment were tested for validity using the KMO Bartlett's test of variance analysis and tested for reliability using Cronbach's alpha. The results of the validity and reliability tests are presented in Tables 2 and 3.

Table 2. Results of the Validity Test of Higher Order Thinking Skills

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.723
Bartlett's Test of Sphericity	Approx. Chi-Square	37.271
	df	3
	Sig.	.000

Table 3. Reliability Test Results of Higher Order Thinking Skills

Reliability Statistics

Cronbach's Alpha	N of Items
.824	3

The assessment of higher order thinking skills was revised based on some suggestions from the validator and then applied to assess students' skills on a small scale trial. The results of the assessment can provide a description or profile of students' higher-order thinking skills in biology education seminar courses. The overall assessment results are presented in Figure 1

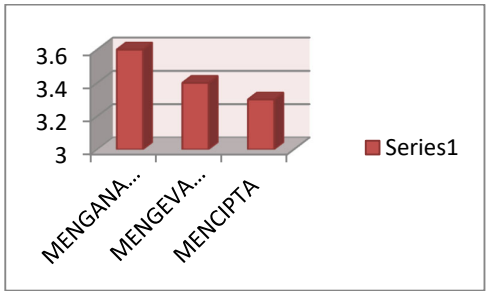

Figure 1. Profile of Students' Higher Order Thinking Skills

The results of the assessment of higher order thinking skills on a small scale trial are analyzing skills of 3.6, evaluating skills of 3.4 and creating skills of 3.3. Based on the results of the assessment, it shows that the skills in creating proposal designs are the lowest, but overall students are competent in making proposal designs based on the results of journal analysis. Higher order thinking skills are an important aspect in the teaching and learning process, especially in universities. The practice of higher order thinking skills can be applied to science courses where students who have higher order thinking skills are able to improve their performance and reduce their weaknesses [9] . In learning that facilitates higher-order thinking skills, it must be precise in the selection of learning strategies and types of assessments so that these assessments can assess according to learning objectives [10].

Higher order thinking requires a person to apply the new information or knowledge he has gained and manipulate the information to reach possible answers in new situations [10] . The selection of the right assessment approach can help improve and evaluate students' higher order thinking skills according to the indicators of learning materials [11] . Learning using a scientific article review strategy can improve cognitive learning outcomes in this case are students' higher-order thinking skills so that an authentic assessment is needed that is developed to assess the assignment of scientific article reviews [12] .

4 Conclusion

This study resulted in an assessment of students' higher thinking skills with a strategy of reviewing scientific articles. The results of expert and user validation indicate that the assessment is valid and feasible to use with minor revisions. The result of the small-scale trial is that the assessment developed has a high value of validity and reliability so that the assessment is worthy of being used as an authentic assessment alternative with good quality.

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