International Journal of Curriculum Development, Teaching and Learning Innovation

Published by: TRIGIN Institute

International Journal of Curriculum Development, Teaching and Learning Innovation

Journal homepage: https://trigin.pelnus.ac.id/index.php/Curriculum/index

Development of evaluation tools HOTS based project learning model to improve critical thingking ability

Radiansyah[1], Fathul Jannah[2], Raihanah Sari[3], Yogi Prihandoko[4], Nahdia Fitri Rahmaniah[5]

[1] Teacher Profession Education, Lambung Mangkurat University, Indonesia

[2,3,4] Primary Teacher Education, Lambung Mangkurat University, Indonesia

[5] Early Childhood Teacher Education, Lambung Mangkurat University, Indonesia

Article Info

Article history:

Received Oct 01, 2024
Revised Oct 15, 2024
Accepted Nov 30, 2024

Keywords:

Evaluation tools;
HOTS;
Project learning;
Critical thinking;

ABSTRACT

21st century learning requires students to have 4C skills (communication, collaboration, critical thinking, and problem solving and creativity and innovation). These skills are high-level thinking abilities or what we usually call HOTS. Critical thinking skills are very important in learning at school so learning and assessment must be designed to develop critical thinking skills. The evaluation tool used must take into account students' higher-order thinking abilities which encourage students to use HOTS abilities. The evaluation tools used in elementary schools are still not HOTS based, so they do not measure critical thinking abilities. Innovation to develop critical thinking evaluation tools in elementary school aims to: (1) produce an assessment instrument that can measure high-level thinking abilities (HOTS), (2) produce an assessment instrument that can measure critical thinking abilities. This research uses a type of development research (Research and Development). The results of the research state that the evaluation tool can be used as an assessment instrument capable of measuring higher order thinking abilities (HOTS) such as critical thinking skills.

Corresponding Author:

Radiansyah,
Teacher Profession Education,
Lambung Mangkurat University,
Brigjend Hasab Basri Street, South Borneo, 71023, Indonesia.
Email: radiansyah@ulm.ac.id

1. INTRODUCTION

Elementary school is an ideal environment for developing HOTS skills because at this age, students have a better ability to learn through direct experience and interaction with the environment around them. The evaluation tools used must take into account students' higher-order thinking abilities that encourage students to use their HOTS abilities (Abdullah & Ridwan, 2014). Developing a HOTS-based Project Learning model evaluation tool in elementary schools, the first step that must be taken is to identify the learning objectives to be achieved. This can be done by selecting relevant topics and determining the HOTS skills you want to develop in the project (Aktamis, 2008).

The Project Learning Model is a model that has been developed through scientific research. Developed from two basic models, namely the Problem Based Learning (PBL) model and the Project Based Learning (PjBL) model. This Project Learning model was created to minimize the shortcomings of the PBL and PJBL models (Habib, 2020 & Bagheri et al., 2013).

This Project Learning model was created with a focus on developing students' critical and creative thinking abilities (Radiansyah, et al., 2022; Dias, 2017). So that this model can be implemented more effectively, other tools are needed that support learning. Learning tools consist of lesson plans, teaching materials, media, LKPD, and evaluation tools. It is very important to develop evaluation tools to support the HOTS-based Project Learning model (Gravemeijer, 2006).

The reality in the field is not as expected because the existing evaluation tools are still not HOTS based, and do not measure critical thinking abilities (Amir, 2010; Chen et al., 2015). Based on these problems, the research seeks to develop an evaluation tool that is very necessary for the Project Learning model in elementary school, with the aim of producing an assessment instrument that can measure high-level thinking abilities (HOTS), namely measuring critical thinking abilities.This research is very important to carry out because the Project Learning model requires appropriate evaluation tools (Movaheddzadeh et al, 2012; Mukra & Nasution, 2016). So that learning outcomes can be analyzed with effective evaluation tools. The evaluation tool developed can improve high-level thinking skills (HOTS) and critical thinking. The resulting evaluation tool can be implemented for five learning contents (science, social studies, mathematics, civics, and Indonesian) in elementary schools (Prasetyo et al, 2017; Jalinus et al, 2013; Kauffman et al, 2008).

The evaluation tool developed can improve students' high-level, critical thinking abilities. This evaluation tool can also be used as an effective measuring tool to determine the success of Higher Order Thinking Skills (HOTS) based Project Learning (HOTS) learning. Evaluation tools are produced in print (books) and digital form using the Quizizz (multiple choice), Kahoot (games), Google Form (essay) applications. The objectives of this research are: (1) to produce an assessment instrument that can measure higher order thinking abilities (HOTS), (2) to produce an assessment instrument that can measure critical thinking abilities.

2. RESEARCH METHOD

This research uses a type of development research. Research and development is carried out to produce a product. This is in accordance with the opinion (Sugiyono, 2013). R&D is a research method used to produce certain products, and test the effectiveness of these products. Apart from that, Borg & Gall (Sumitro et al, 2017) also stated that development research aims to produce products based on the findings from a series of trials, through individuals, small groups, medium groups, field trials, revised to obtain results or products that are adequate or suitable for use. The type of R&D research used in this research is the Borg and Gall design model (Borg & Gall, 2003). This research was carried out for nine months and aimed to develop a HOTS-based Project Learning evaluation tool in wetland elementary schools in Banjar Regency.. The research stages can be detailed as follows: (1) pre-field stage or preparation stage, (2) advanced stage, development of HOTS-based Project Learning evaluation tools, (3) post-field stage where the research team prepares a report.

Development activities also carry out testing of various requirements, including: data normality test, homogeneity, to the T test using Hake and n-gain analysis. The data collection techniques used in this research are carrying out a pretest (initial test), providing treatment, carrying out a posttest (final test) (Radiansyah et al., 2022).The data analysis techniques used in this research are as follows: Giving scores to test results in the form of pretest and posttest, the scores obtained by students from the test are converted into grades with a range of 0-100 using the formula according to (Uno, 2017):

$$Value = \frac{Student\ scores}{maximum\ scores} \times 100$$

Figure 1. Value Calculation

a. Data from scoring the test results obtained by students, then categorized according to intervals and critical thinking skills, according to (Ardhanaswari, 2020) can be seen in the following table:

Table 1. HOTS Thinking Skills Intervals and Categories

Interval	Category
76 - 100	Very skilled
51 – 75	Skilled
26 – 50	Quite Skilled
0 – 25	Less skilled

b. Calculate the average score of the pretest and posttest results using the formula according to (Supardi, 2016) as follows:

$$\bar{X} = \frac{\sum xi}{n}$$

Figure 2. Average Calculation

$\bar{X}$: mean
$\sum xi$: total score for each pretest or posttest data
n : lots of data

c. After getting the average score from the pretest and posttest results, continue by calculating the standard deviation (s) of the scores from the pretest and posttest results using the formula according to (Supardi, 2016) as follows:

$$s = \sqrt{\frac{\sum xi^2 - \frac{(\sum xi)2}{n}}{n-1}}$$

Figure 3. Standard Deviation Calculation

d. Calculate the variance (s2) of the pretest and posttest scores using the formula according to (Supardi, 2016) as follows:

$$s^2 = \frac{\sum xi^2 - \frac{(\sum xi)2}{n}}{n-1}$$

Figure 4. Variance Calculation

e. Apply normality using the Kolmogorov-Smirnov test technique if the data being tested is single data or single frequency data, not data in a group frequency distribution. Carry out a homogeneity test using the formula according to Sundayana (2014) as follows:

$$F_{hitung} = \frac{high\ varians}{low\ varians}$$

Figure 5. Normality Calculation

f. Improving competency that occurs before and after learning is calculated using the normalized gain formula according to (Sundayana, 2020) as follows:

$$g = \frac{skor\ posttest - skor\ pretest}{skor\ ideal - skor\ pretest}$$

Figure 6. Normality Calculation

g. Data from the results of competency improvement calculated using the normalized gain formula, then categorized according to standards according to Hake (Sundayana, 2020) can be seen as follows:

Table 2 Temporalization Gain Categories

Normalized Gain Value	Interpretation
-1,00≤g<0,00	There was a decline
g = 0,00	There was no decline
000<g<0,30	Low
0,30 ≤g<0,70	Currently
0,70≤g<1,00	Height

h. Test the comparability hypothesis using the t-test according to (Supardi, 2016) as follows:

$$t = \frac{Md}{\sqrt{\frac{\sum x_d^2}{n\,(n-1)}}}$$

Figure 6. Hypothesis Calculation (Mardhapi, 2008)

Information:

t : Hypothesis test
d_i : difference between the after score and the before score for each subject (i)
M_d : average of gain (d)
X_d : deviation of the gain score from the average (Xd = di – Md)
X^2_d : square of the deviation of the gain score from the mean
N : number of samples (research subjects)

Explaining research chronological, including research design, research procedure (in the form of algorithms, Pseudocode or other), how to test and data acquisition (Wijnen et al., 2017)(Calero et al., 2013). The description of the course of research should be supported references, so the explanation can be accepted scientifically (Morita & Seiford, 1999)(Land et al., 1994). Tables and Figures are presented center, as shown in Table 1 and Figure 1, and cited in the manuscript before appeared (Chen et al., 2019).

3. RESULTS AND DISCUSSIONS

In this section, it is explained the results of research and at the same time is given the comprehensive discussion. Results can be presented in figures, graphs, tables and others that make the reader understand easily (Bayraksan & Love, 2015)(Jiang & Guan, 2016). The discussion can be made in several sub-chapters. Based on the research that has been carried out, the research results were obtained from students' skill test scores, namely the initial test (pretest), final test (posttest), and increasing scores between pretest and posttest using Project Learning model evaluation questions, as follows:

Table 3. Initial test score analysis (Pretest)

Data	Student (n)	Mean	Standar Deviation	Varians	Min Scores	Max Scores
Pretest	19	46,32	47,58	2264,3	10	70

Based on the table above, it can be seen that the student average before being given action was 46.32, with the lowest score being 10 and the highest score being 70, as well as a standard deviation of 47.58 and a variance of 2264.3.

Tabel 4. Initial test score analysis (Posttest)

Data	Student (n)	Mean	Standar Deviation	Varians	Min Scores	Max Scores
Posttest	19	86,32	88,68	7864,33	70	100

Based on the table above, it can be seen that the student average before being given action was 46.32, with the lowest score being 10 and the highest score being 70, as well as a standard deviation of 47.58 and a variance of 2264.3.

Table 5. Pretest and Posttest Homogeneity Test Results for Project Learning Evaluation Tools

Data	Homogenitas			decission
	Varians	Fhitung	Ftabel	
Awal (pretest)	2264,3	3,47	4.45	Homogen
Akhir (posttest)	7864,33			Homogen

Based on the table above, it can be seen that after carrying out a homogeneity test on the initial and final test scores, it was found that Fcount < Ftable or 3.47 < 4.45.

Table 6. Pretest and Posttest N-Gain Value Test

	Pretest	Posttest	Gain	Kategori
Jumlah	880	1640	0,75	Tinggi

As for increasing critical thinking skills and skills by 0.75. The gain in students' critical thinking skills in class V of SDN Sungai Lakum 1 is 0.75, which is in the high category.

Table 7. Table results

N	Dk (N-1)	α	Ttabel
19	18	0,05	1.73961

Based on table 7, it can be seen that the results of the t test on the pretest and posttest scores carried out hypothesis testing, then the t value (tcount) was compared with the t-value from the t distribution table (ttable). The way to determine the ttable value is based on the significance level (α=0.05) and dk = n-1, so dk = 19 – 1 = 18, then ttable is seen in the t distribution table with dk = 47.

Table 8. T test Pretest and Posttest Scores

N	M_d	$\sum_{xd_2}$	Ttable	Tcount	Hypothesis	conclusion
19	18,9	4400	1.73961	11,15	Tolah Ho	Significance

Based on the table above, it can be seen that tcount = 11.15 and ttable = 1.73961 then compared tcount with ttable it can be concluded that tcount > ttable, which means that rejecting Ho means it is significant. This means that at the 95% confidence level there is a significant difference between before (pretest) and after (posttest) the action given by applying the HOTS-based Project Learning Evaluation tool.

This research consists of several aspects that become the focus of research, namely learning tools and product trials. The results of the development of learning tools consisting of four aspects, namely (1) lesson plan validation test, (2) students worksheet validation test, (3) validation test of teaching materials, (4) evaluation sheet validation test, was declared very good, which means the learning product could be continued with the practicality test. The teacher conducted the results of the product practicality test in the field of biology studies by filling out a response questionnaire to the resulting product. It is concluded that the product developed was in a good category. The results of this study are in accordance with the research of Mukra and Nasution (2016), which explains that Project Learning is higher than Problem Based Learning. The Project-Based Learning model has more

advantages: increasing motivation, improving problem- solving skills, improving literature study skills, increasing collaboration, and improving resource management skills.

Critical thinking is needed to generate new ideas in order to solve problems, make improvements, increase effectiveness, and add value (Isa and Jamil, 2012). The same thing was conveyed by Plucker (Kaufman et al., 2008) that critical thinking makes a person or group able to produce new and useful products. Learning by utilizing Project learning-based interactive multimedia can help critical meaningful learning for students (Habib et al., 2020). In learning using learning tools with an ethnoscience approach, students are actively involved in learning so that they have a better understanding than students who study conventionally. Students who are active in learning activities will have better understanding and learning outcomes than students who only listen to the teacher's explanations and are passive during the learning activities (Shahali & Halim, 2010). As stated by Karamustafaoğlu (2011) that science process skills are thinking abilities that are used to obtain information. The Project learning is a method in which students engage in intellectually challenging tasks that encourage the acquisition of knowledge and skills used in solving complex problems (Movahedzadeh et al., 2012).

Bagheri et al. (2013) said that one of the advantages of project-based learning is that students determine their own project goals and choose projects according to their own interests. The evaluation stage is the tools that has been designed based on the development steps, and then a thorough evaluation needs to be carried out to ensure that the tools is in accordance with the project learning model steps. According to Aldoobie (2015), the evaluation of the project learning model aims to evaluate every step that has been achieved by using instructional design and materials to meet student needs. Applications of real-world theory, exploratory opportunities and practical design skills, and peer learning are considered by students as the most valuable aspect of project experience (Chen et al., 2015). Project- learning provides opportunities for students to build this quality and learn more deeply the traditional academic content and understand how it applies to the real world (Dias & Brantley-Dias, 2017).

Sumantri et al. (2015) said that Project Learning is the application in education is to enhance the creative abilities of learners, collaboration capabilities, and self-direction. Yalcin (2009) that project-based learning can affect attitudes, motivation to learn physics, and thinking skills development. Through Project learning activities, students have high motivation to develop their competencies because student project assignments are real projects raised from problems that develop in the community (Jalinus et al., 2017).

4. CONCLUSION

Project learning evaluation tools can be used as assessment instruments that can measure high-level thinking abilities (HOTS), can measure critical thinking abilities. Based on the research results, several unsolved problems were found, So the researchers put forward several suggestions for teachers that are very necessary in understanding and implementing HOTS-based learning. Teachers are expected to better understand HOTS learning so they can develop HOTS-based evaluation tools, to improve critical thinking skills. Teachers must also develop their knowledge of HOTS learning, for this reason service activities are needed to help teachers who do not understand HOTS learning.

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