International Journal of Business, Law, and Education
Volume 4, Number 2, 2023

DEVELOPMENT OF PERFORMANCE APPRAISALS AS AN ALTERNATIVE TO MEASURING CRITICAL THINKING SKILLS IN ELEMENTARY MATHEMATICS LEARNING

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Abstract
This study aims to produce a performance assessment instrument as an alternative to measure critical thinking skills in elementary mathematics learning. This study describes the process of developing assessment instruments and rubrics used to measure critical thinking skills in grade IV elementary school mathematics learning. This research was conducted in elementary schools in DKI Jakarta. The development of performance appraisal instruments as an alternative to measuring critical thinking skills in elementary mathematics learning is research and development (*Research and Development* / R &D) using *mixed methods research.* The model used in this study is the ADDIE development model *(Analyze, Design, Development, Implementation, Evaluation*). This research has just been carried out with the stages carried out in this study *Analyze, Design, Development,* and *Implementation.* Data collection using non-test techniques, namely interviews and product assessments. Data was analyzed using descriptive analysis techniques including *expert judgment* conducted by material experts (elementary mathematics learning), learning evaluation, and language. The calculation of validation results using Aiken's statistics v and instrument reliability is *inter-rater reliability* calculated using the Hoyt variance technique. VProduct feasibility alidation in terms of material, construction, and language aspects. The results of the analysis show that all instrument items are valid with a reliability coefficient of 0.98. The feasibility test results showed that the average feasibility of material aspects was 86.7%; construction aspect by 92%; and the language aspect of 90.7% with an overall average of 89.8%. These results show that the performance assessment instrument as an alternative to measuring critical thinking skills in grade IV elementary mathematics learning is categorized as very feasible. Thus, this instrument can be used in grade IV elementary mathematics learning.

Keywords:
Performance appraisal; critical thinking skills; Elementary Mathematics Learning

INTRODUCTION

Education has an important role as an investment in the future to achieve a prosperous life. For this reason, the quality of education is very important for a nation to lead to a nation that is able to keep up with the times. The functions and objectives of national education as stated in Law of the Republic of Indonesia Number 20 of 2003, Article 3 provides an overview of the need for standards that must be achieved within a certain period of time to realize educational goals.

Government Regulation Number 13 of 2015 concerning the second amendment to Government Regulation Number 19 of 2005 concerning National Education Standards. Government Regulation Number 13 of 2015, Article 1 Paragraphs 5 and 6 states that: "Efforts in realizing the goals of national education have been determined graduate competency standards which are criteria regarding the qualifications of graduate abilities which include attitudes, knowledge and skills.

To achieve the competence of graduates, it is necessary to establish content standards which are criteria regarding the scope of material and the level of competence of students to achieve graduate competence at certain levels and types of education (President of the Republic of Indonesia, 2015).

To achieve graduate competence, of course, a curriculum is needed that is able to be a guide in developing student potential. The 2013 curriculum emphasizes competency learning by strengthening authentic learning and assessment processes to achieve attitude, knowledge and skill competencies. Assessment is important to achieve competence in both attitudes, knowledge, and skills considering that assessment is an important and inseparable part of learning. For this reason, a good assessment system will be able to provide an overview of the quality of learning so that it will be able to help teachers plan learning strategies. For students, a good assessment system will be able to provide motivation in improving their competence.

Wrong One form of assessment used in learning with the 2013 curriculum is performance appraisal. Performance appraisal (*Performance Assessment*) is the process of collecting data by means of systematic observation to make decisions about individuals. This assessment has an important role, which allows students to apply their knowledge and skills in real tasks (Stretcher, 2010). By using *Performance Assessment*, educators get a complete picture of what learners know and do (Oberg, 2012). Use *Performance Assessment* in the classroom makes learning more active and students are more motivated towards the teaching material (Omidi, Sridhar, and Azizmalayeri, 2012). *Performance assessment* has advantages, namely: (1) Can measure learning outcomes that cannot be measured by other types of assessment; (2) Usage *Performance Assessment* consistent with modern learning theory; (3) allow to produce better learning; (4) make learning more meaningful and motivate learners; (5) enable assessing the process as well as assessing the results; and (6) extend the approach to other types of assessment. Superiority *Performance Assessment* boils down to improving the quality of learning (Reynolds, *Et. Al.* 2010).

One of the student competencies that is considered important in preparing students to be able to face the rapid development of the times is the ability to think critically. In real life, critical thinking skills are necessary whenever people grapple with complex problems and messy, obscure problems (Halpern, 1998). For this reason, the importance of critical thinking skills requires teachers to practice critical thinking skills from an early age. It should be important to practice critical thinking skills because these critical thinking skills are not born (Redhana and Liliasari, 2008).

One of the critical thinking skills needed in facing the challenges of the 21st century marked by the industrial era 4.0 and the era of *society* 5.0 is the ability to think critically mathematically. This is considering the important role of mathematics in everyday life. Mathematics is a universal science that underlies the development of modern technology, has an important role in various disciplines and advances human thinking. Mathematics is a tool to develop thinking skills, therefore mathematics is indispensable both in everyday life and in the advancement of science and technology (IPTEK).

However, the ability to think critically in mathematics achieved by students is still categorized as unsatisfactory. This is in accordance with what was stated Minister Education and Culture Muhadjir Effendy, did not deny the spotlight of a number of

domestic and foreign researches, related to Indonesia experiencing a mathematics emergency. Various studies show that students ranging from elementary to high school are considered less able to solve problemsmathematics simple. It was stated that "Mathematics emergency, yes we (Ministry of Education and Culture) have always known, if mathematics is severe. So this is not a new issue, the Education and Culture already understands it," said Muhadjir Effendy at the Coordinating Ministry of PMK Office, Jalan Medan Merdeka Barat, Central Jakarta, Monday, November 12, 2018 (Yaspen Martinus, 2018).

To improve critical thinking skills, of course, in addition to using test techniques, non-test techniques can also be used, namely performance assessment. This is because critical thinking requires problem-solving skills to overcome egocentric thinking that is only centered on existing solutions. In other words, critical thinking requires skills to recognize problems and formulate questions to find logical solutions (Paul &; Elder, 2008). Critical thinking if experiencing the following eight characteristics: (1) knowing the issue, problem, activity, or decision under consideration; (2) know the point of view of the problem; (3) describe an event; (4) make assumptions, (5) use clear and effective language, (6) prove assumptions; (7) make conclusions; and (8) knowing the consequences of decisions made (Johnson, 2002).

The ability to think critically mathematically is a skill to think effectively and reflectively that can help a person to make, evaluate, and make decisions about what is believed or done. By thinking critically mathematically, a person is able to understand the purpose and purpose of every action taken so as to be able to make the right decision (Jumaisyaroh, 2014). The ability to think critically mathematically is often referred to as the goal or outcome of education (Perkins & Murphy, 2006).

One of the instruments used in measuring critical thinking skills is performance assessment. *Performance* assessment is an assessment that emphasizes aspects of the skills shown by students and not an assessment of just answering or choosing answers from a series of possible answers that are already available. *Performance assessment* not only informs teachers about student learning progress, but also informs students and parents about their success in real life (Wren, 2009). The essence of performance *assessment* is to assess real tasks and performance that students can show (Gipps &; Stobart, 2010).

Research related to the assessment of critical thinking skills is *"Development of An Integrated Instrument About Critical Thinking Skills And Chemical Literacy In Hydrolysis"*. This research is a form of test used to measure chemical literacy (Khayati, 2018); "Development of High School Student Critical Thinking Skills Assessment Instrument on Acid-Base Material". The assessment instruments developed are analytical essay tests, student activity sheets*, and problem solving* tests oriented to students' critical thinking skills (Amalia and Susilaningsih, 2014); Research on "Development of High School Student Critical Thinking Skills Assessment Instrument on Digestive System Material" (Putri, Nevrita, and Hindrasti, 2019); Research on "Analysis of Critical Thinking Skills of Elementary School Students in Mathematics Learning Curriculum 2013" (Azizah, Sulianto, and Cintang, 2018).

Research related to performance appraisal identified is about Performance Appraisal as an Alternative to Measuring Students' Critical Thinking Ability. This

research was conducted from a case study on students majoring in mathematics mathematics education study program in mathematics learning assessment courses. (Endang Retno W., Rochmad, and St. Budi Waluya, 2018). Furthermore, research aims to develop performance assessment of *peer assessment* techniques in class XI biology learning that meet valid, reliable, and practical criteria for use (Basri, St., Syamsuddiha, and Taufiq, 2017). Another research that aims to produce a product in the form of learning tools, namely assessment instruments used to assess student performance tasks that are valid, practical, and effective (Rahmawati, Syamsudduh, and Uma, 2019).

Further research aimed at evaluating and developing existing performance appraisal systems and describing the process of developing performance appraisal systems in retail companies and supermarkets (Wijayanti and Wimbarti, 2012); to produce generic science-based practicum performance appraisal device products to measure students' skills (Sumarni, Sriyono, and Ngazizah, 2016); Development of Asta Brata's competency-based village head performance appraisal instrument. The purpose of research on the development of the asta brata leadership model measurement tool is to produce asta brata leadership measuring instruments along with norms in the Indonesian version and have validity and reliability that can be accounted for (Hidayat and Setiyowati, 2017); research to explain the process of developing lecturer performance assessment instruments in universities (Yusrizal, 2017); aims to develop a performance appraisal instrument to measure student competence in chemistry practicum activities at SMA / K (Kusumaningtyas, Yusvitasari, and A Majid, 2018); research on Development of Performance Appraisal Instruments for Speaking Skills in Learning Indonesian. (Bukian, 2017); research to explain the development of a performance assessment rubric to measure student competence in conducting plant ecology practicum (Sitompul*, 2017*).

Based on the description above, this study examines the development of performance appraisal instruments as an alternative to measuring critical thinking skills in elementary mathematics learning. This instrument can be used as an assessment instrument in addition to a form of test to measure critical thinking skills in elementary mathematics learning.

RESEARCH METHODS

This study aims to develop a performance appraisal instrument as an alternative to measure critical thinking skills in elementary mathematics learning. This research will be conducted at SD Negeri Duren Tiga 01 Pagi South Jakarta, DKI Jakarta Province from February to October 2021.

This research is a *Research and Development* (*R&D) with* ADDIE (Analyze, Design, Development, Implementation, Evaluation) *development model*. In the analysis stage, researchers review documents about the curriculum, syllabus, and learning tools used in grade IV elementary mathematics learning and conduct interviews with teachers and students to synthesize information about the need for performance appraisal instruments to measure critical thinking skills to be developed. In the *Design stage*, researchers compile a schedule for developing performance appraisal instruments to measure critical thinking skills in elementary mathematics

learning; choose basic mathematics competencies in grade IV elementary school that contain critical thinking skills; and compile indicators according to the selected grade IV elementary school Basic Mathematics Competencies. In the *Development stage*, researchers develop a model framework of performance appraisal instruments to measure critical thinking skills; develop a blueprint of performance appraisal instrument models to measure critical thinking skills; developperformance appraisal instruments to measure critical thinking skills (accompanied by assessment rubrics); andperform stage 1 validation. At the *Implementation stage,* researchers revise products based on the results of stage 1 validation; and carried out stage 2 validation involving material experts, evaluation experts, linguists, and grade IV teachers of SDN Duren Tiga 01 Pagi South Jakarta.

Data collection using non-test techniques, namely interviews and product assessments. The interview instrument is used for needs analysis given to teachers and grade IV elementary school students, while the product assessment instrument is used for product validation used by material experts (mathematics learning), learning evaluation experts, linguists, and grade IV elementary school teachers.

The data analysis technique used in this study is a descriptive analysis to describe needs based on preliminary research that serves as a basis for conducting development research. Descriptive analysis techniques used at the *Development* stage include expert judgment. At the expert judgment stage, researchers conduct construct validation tests. This construct validation was carried out by three experts, namely elementary mathematics learning experts, learning evaluation, and language. Calculation of validation results using Aiken's statistics$v$. The criteria in the construct validation test using Aiken's V formula, instrument items are said to be valid if the validity score ≥ 0.87 (Hartanto, Ani Rusilowati, and Kartono, 2019). The reliability of the critical thinking ability assessment instrument in grade IV elementary school mathematics learning is inter-rater *reliability (inter-rater reliabiliy*) calculated using the Hoyt variance technique. And use reliable and consistent categories if the reliability coefficient ≥ 0.6 (Rusilowati &; Sujarwanto, 2015).

The feasibility of performance assessment instruments as an alternative to measuring critical thinking skills in elementary mathematics learning according to the following calculation results:

$$\text{Response (\%)} = \frac{Total\ Skor}{Total\ Skor\ Maksimum} \times 100\%$$

Data processing of validation results using the Likert scale with a score range of 1-5. The questionnaire used during product testing and validation uses the options "Yes" (score 1) and "No" (Score 0) (Riduwan, 2015). The feasibility of performance assessment instruments as an alternative to measuring critical thinking skills in elementary mathematics learning is carried out by interpreting validation data in percentage form using:

Table 1. Product Eligibility Criteria

Score	Criterion
0 - 20	Not Worth It
21 - 40	Less Decent
41 - 60	Pretty Decent
61 – 80	Proper
81-100	Very Worth It

The feasibility of performance assessment instruments as an alternative to measuring critical thinking skills in elementary mathematics learning is declared feasible if a percentage of ≥ 61% is obtained (Riduwan, 2015).

RESULTS AND DISCUSSION

The stages carried out in this study are in accordance with the ADDIE model as follows:

At the *analysis* stage, researchersreview documents about the curriculum, syllabus, and learning tools used in grade IV elementary school mathematics learning. Researchers tried to obtain information about the curriculum, syllabus, learning tools used in grade IV elementary mathematics learning, types and forms of instruments designed by teachers in mathematics learning, and the characteristics of grade IV elementary school students. The next activity conducted interviews with teachers and sides to synthesize information about the need for performance appraisal instruments to measure critical thinking skills to be developed. At this stage, researchers make observations on several learning devices used by teachers. Researchers examine the compatibility between the indicators designed in the Learning Implementation Plan (RPP) and the assessment instruments used by teachers in carrying out assessments.

At the design stage, researchers compile a schedule for developing performance appraisal instruments to measure critical thinking skills in elementary mathematics learning; choose a grade IV elementary mathematics basic competency that contains critical thinking skills; compile indicators according to the selected grade IV elementary school Basic Mathematics Competency; identify the purpose of the performance appraisal instrument to measure critical thinking skills; and design performance appraisal instruments for measure critical thinking skills in elementary mathematics learning (accompanied by assessment rubrics) that will be used in product validation, field tests, and evaluation. The target of this stage isto produce a schedule that includes making the initial product design, product development, product validation, product revision, and making the final product; mproduce input model performance appraisal instruments to measure critical thinking skills in Grade IV Mathematics learning (accompanied by an assessment rubric) ready for development; and provide blueprints for critical thinking assessment instruments and instruments for testing critical thinking ability assessment instrument products. In developing this assessment instrument, researchers use Basic Competencies and learning indicators as follows.

Table 2. Basic Competencies and Performance Appraisal Instrument Indicators to Measure Critical Thinking Skills in Elementary Mathematics Learning

Basic Competencies	Indicators
4.4 Solve problems related to the perimeter and area of squares, rectangles, and triangles including involving powers of two with square roots	4.4.1 Resolving problems with regard to square area involving powers and square roots 4.4.2 Resolving problems with regard to rectangular area involving powers and square roots 4.4.3 Solve problems with regard to the area of triangles involving powers and square roots.

In the *development stage*, researchersdevelop a framework of performance appraisal instrument models to measure critical thinking skills; create a blueprint for a performance appraisal instrument model to measure critical thinking skills; and develop a performance appraisal instrument to measure critical thinking skills (accompanied by an appraisal rubric). The target at this stage is to produce a draft model of a performance appraisal instrument to measure critical thinking skills; andobtain the results of stage 1 validation to make revisions. Validation stage 1 is carried out through expert *judgment*. Expert assessment of products is carried out by three people, namely mathematics learning experts, learning evaluation experts, and language experts. Assessment of products is carried out validation, namely construct validity and reliability. Furthermore, determine feasibility using questionnaires consisting of aspects of material, construction, and language. A recapitulation of product assessment by experts is as follows:

Table 3. Instrument grain validity coefficient

Item Number	Aiken's V Score	Information
1	0,9	Valid
2	0,9	Valid
3	0,89	Valid

The reliability coefficient of the instrument for assessing critical thinking skills using the Hoyt variance technique was obtained 0.98. These results show that performance appraisal instruments to measure critical thinking skills are reliable. Recapitulation of the results of the assessment of aspects of material, construction, and language on performance assessment instruments to measure critical thinking skills in elementary mathematics learning conducted by material experts (Elementary Mathematics Learning), learning evaluation experts, and linguists (Phase I) as follows.

Table 4. Recapitulation of Expert Test Data Analysis Results (Phase I)

No.	Members	Average Score	Criterion
1.	Material	78,7%	Proper
2.	Construction	76%	Proper
3.	Language	74,7%	Proper
Overall Average		76,4%	Proper

Based on the results of the recapitulation, the average assessment of performance assessment instruments to measure critical thinking skills in elementary mathematics learning as a whole is 76.4%. In accordance with the reference criteria for product assessment, a score of 76.4% means feasible.

At the *implementation stage*, researchersrevise the product based on the results of stage 1 validation. Furthermore, conducting stage 2 validation involving material experts, evaluation experts, linguists, and grade IV teachers of SDN Duren Tiga 01 Pagi South Jakarta. Recapitulation of the results of the assessment of aspects of material, construction, and language performance assessment instruments to measure critical thinking skills in elementary mathematics learning conducted by material experts (Elementary Mathematics Learning), learning evaluation experts, linguists, and Grade IV elementary school teachers (Phase II) as follows.

Table 5. Recapitulation of Expert Test Data Analysis Results (Phase II)

No.	Expert	Average Score	Criterion
1.	Material	86,7%	Very Worth It
2.	Construction	92%	Very Worth It
3.	Language	90,7%	Very Worth It
Overall Average		89,8%	Very Worth It

Based on the recapitulation results, the average assessment of performance assessment instruments to measure critical thinking skills in elementary mathematics learning as a whole is 89.8%. Thus, based on the assessment of experts and teachers of Grade IV elementary school, the performance assessment instrument to measure critical thinking skills in elementary mathematics learning is said to be very feasible.

The development of performance appraisal instruments as an alternative to assessing critical thinking skills uses the ADDIE (Analyze, Design, Development, Implementation, Evaluation*) development model*. The stages of ADDIE research and development consist of: (1) *Analyze*; (2) *Design*; (3) *Development*; (4) *Implementation*; and (5) *Evaluation* (Gavarkovs, Blunt, *and* Petrella, 2019).

The results of phase I validation conducted by material experts (Elementary Mathematics Learning), Learning Evaluation, and Language on aspects of material, construction, and language showed an average product feasibility score of 76.4% with the feasible category. After revision of the product based on input from all experts, the results of stage 2 validation carried out by material experts (Elementary Mathematics Learning), Learning Evaluation, and Language and Grade IV elementary school teachers on aspects of material, construction, and language showed an average product feasibility score of 89.8% with a very feasible category. Based on the results of this development, the performance assessment instrument can be used to measure the critical thinking ability of grade IV students in elementary mathematics learning.

This performance assessment instrument to measure critical thinking skills is a development product that can assist in carrying out assessments in elementary mathematics learning. This is considering that performance appraisal is one form of assessment that can be used in addition to test form assessment. This assessment is based on *performance* shown in completing a task or problem related to the exposure of knowledge, the use of reasoning, demonstrating *skills* or products, and

attitudes / affective. Thus, performance assessment is an assessment that demands responses related to skills in carrying out an activity or behavior in accordance with competency demands. Robert (2009) explains that through performance appraisal, students demonstrate knowledge and skills in a process or in producing a product. Performance appraisal involves students in explaining problems, identifying historical patterns, establishing cause-and-effect relationships. Performance appraisals always describe: (1) the freedom of students to determine the tasks to be performed, (2) tasks that determine students collaborate on the use of the learning process as a key in understanding the core learning material, (3) tasks designed can not only be assessed by teachers but assessed by others (parents and community), explicit assessment systems, and accurate measurement processes in line with planned tasks made (Abidin, 2014).

Performance appraisal is an assessment technique that is suitable for measuring students' critical thinking skills. A series of activities carried out by students through performance appraisals can improve students' critical thinking skills. The ability to solve problems by identifying existing information can improve students' mathematical critical thinking skills (Hager, 2003).

Critical thinking skills are one of the important things in the process of solving a problem (Indah Dwi Wijayati, Badarudin, and Shanty Hawati, 2020). However, critical thinking requires problem-solving skills to overcome egocentric thinking centered solely on existing solutions. Critical thinking requires skills to recognize problems and formulate questions to find logical solutions. Critical thinking in mathematics learning certainly also requires problem-solving skills. Thus students are required to be familiar with mathematical problems that can be solved using conceptual and procedural knowledge. Critical thinking in mathematics learning is an organized process that allows students to evaluate evidence, assumptions, logic, and the underlying language of statements. The characteristics of a person are said to have thought critically in mathematics learning: (1) understanding the issue, problem, activity, or decision under consideration; (2) understand the point of view of the problem; (3) describe an event; (4) formulate assumptions, (5) use clear and effective language, (6) prove assumptions; (7) make conclusions; and (8) know the consequences of the decisions made.

In critical thinking, activities are needed that students need to do. Critical thinking is a skilled activity that requires interpretation and evaluation of observation, communication, and other sources of information and requires skills in thinking assumptions, asking relevant questions, drawing implications and debating issues continuously to obtain a decision (Fisher, 2009). To measure this, of course, it is not enough just to use test assessment, but a form of assessment is needed that is able to measure these characteristics. Thus, the performance appraisal instrument can be said to be an alternative instrument that can be used in measuring critical thinking skills in mathematics learning, especially in elementary schools.

CONCLUSION

The development of performance assessment instruments to measure critical thinking skills in elementary mathematics learning is carried out through the following stages: (1) *Analyze*; (2) *Design*; (3) *Development*; and (4) *Implementation*. Based on

the results of product validation conducted by material experts (mathematics learning), learning evaluation experts, and linguists on performance appraisal instrument products to measure critical thinking skills, it shows that performance appraisal instruments to measure critical thinking skills in grade IV elementary school mathematics learning are categorized as very feasible. Thus, it can be argued that performance assessment instruments to measure critical thinking skills in mathematics learning grade IV elementary school can be used in carrying out mathematics learning assessments in grade IV elementary school.

However, in order for the performance appraisal instrument product to measure critical thinking skills in grade IV elementary school mathematics learning to be more accountable, the next stage of research is to perfect the stages of the ADDIE model used, which will carry out the *Implementation* and *Evaluation stages*. In the *Implementation* stage, researchers will conduct field trials with stages: *one to one*; *small group,* and *field test.*Furthermore, it will revise the product based on the results of field trials. In *the Evaluation* stage, researchers will conduct formative evaluations on grade IV elementary school students; revise products based on the results of formative evaluations; and develop final products.

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