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Quality of Student worksheet Based on Critical Thinking Skills in The Topic of Properties of Light

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Abstract

Critical thinking is the ability to analyze and evaluate information logically. This research aims to test the validity, practicality and improvement of critical thinking of fifth grade students at SD Negeri 106162 Medan Estate using student worksheet based on critical thinking skills on the properties of light. The research method used is research and development with the ADDIE model. The research results show that the student worksheet based on critical thinking skills has high validity, good practicality, and can improve students' critical thinking skills. It can be seen that the validity of the student worksheet which was developed using a validation sheet and the average validator is 86, so that the student worksheet based on critical thinking skills is included in the very valid category criteria. The practicality of the Student worksheet was measured using an educator questionnaire sheet and the average student response was 85.49 in the very practical category. The effectiveness of the student worksheet is measured by looking at changes in the pretest and posttest results, which show an increase in students' critical thinking skills at a percentage of 65% in the quite effective category. Based on the results of this research, it can be concluded that student worksheet based on critical thinking skills can be used as teaching material in student learning.

Keywords: critical thinking skills, properties of light, student worksheet

INTRODUCTION

Critical thinking skills are an attitude of thinking deeply when solving problems or carrying out evaluations that are based on truth (Purnami et al., 2021). Critical thinking skills are important to apply in teaching and learning activities, especially in Natural Sciences lessons. Critical thinking is a directed and clear process used in mental activities such as solving problems, making decisions, persuading, analyzing assumptions and conducting scientific research (Marudut et al., 2020; Haviz et al., 2020). Meanwhile, the goal of critical thinking is to achieve a deep understanding of something. Critical thinking skills are the ability to analyze facts, generate and organize ideas, evaluate arguments, and solve problems.

If critical thinking is developed, a person will tend to seek the truth, think divergently (open and tolerant to new ideas), be able to analyze problems well, and be able to think independently (Sidiq et al., 2021; Astawan et al., 2023) . The ability to think critically will make a person wiser in making decisions because the ability to think critically helps us to be able to explain and analyze systematically an idea or thought to then be developed (Wibowo et al., 2024).

The objectives of thinking according to

(Inandhi Trimahesri et al, 2019; Isnaeni et al., 2021) in learning are: 1) develop individual abilities to the maximum, both physically, most philosophically, aesthetically and intellectually 2) prepare students to meet economic needs independently and ready to face the world of work. teaches students to obtain and produce desired needs and services, and manage one's resources efficiently and 3) prioritize responsibility for active participation in society, namely creating an environment that is conducive to human survival and using it effectively for a more prosperous community (Verawati et al. al., 2021).

Critical thinking is very important for students because critical thinking allows students to study problems systematically, face challenges in an organized way, formulate innovative questions, and design original solutions (Andi Wahyuni et al., 2023; Lestari et al, 2021). Critical thinking aims to make students able to transfer abstract principles by applying them in everyday life. Students who can think critically will collect and assess relevant information, produce conclusions and solve problems with good reasons (Astawa et al., 2022; Rapi et al., 2022).

Prasadi (2020); Tanti et al. (2020); Pursitasari et al. (2020) states that there are 4 stages of the critical thinking process, including: (1) Clarification, namely understanding the problem and then stating all known data and the main problem correctly; (2) Assessment, namely students analyze information by identifying relevant information and finding important questions in the problem and determining logical reasons that support the information and then proposing solutions, (3) Inference, namely students make conclusions based on the information which is obtained by combining relevant information and then making generalizations, (4) Strategies, namely students think openly in solving problems by evaluating the steps and results of problem solving and determining other solutions in solving problems.

Some of the explanations above have shown the importance of critical thinking skills, especially developed in the world of education. Based on the results of observations made by researchers at SDN 106162 Medan Estate, it shows that teachers have not been optimal in facilitating learning media during the science learning process. The learning process shows that teachers are not optimal in using learning media. This results in students not being able to find their own knowledge and students not playing an active role in learning so that they do not direct students to think critically.

The teacher's ability to utilize media has not been maximized to create a pleasant atmosphere so that he has not been able to attract students' interest and create an effective learning process. The use of appropriate learning media can attract students' attention, and have a good effect on student learning outcomes as well as increasing interest or interest in studying the material with the availability of images and videos presented (Sari, 2019).

Critical thinking skills are part of cognitive skills based on constructivist

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learning theory. The constructivist view makes students gain new knowledge from the old knowledge they have (Mardhatillah et al., 2020). One way that can be done to improve critical thinking skills is to provide facilities so that students are actively involved in using student worksheet. Through student worksheet, students can express ideas, express opinions in criticizing problems, be actively involved and take control to solve the problems they face (Amalia et al., 2022; Danil et al., 2023; Sumarni & Kadarwati, 2020).

Criteria of good student worksheet for students is student worksheet that is made interesting, the material can be understood, helps students' understanding in learning and can improve student learning outcomes or students' thinking abilities (Sari et al., 2019; Basri et al., 2020). Student worksheet is also teaching material that can be used to facilitate students so they can easily learn the material. Apart from that, student worksheet based on critical thinking skills can also be used by teachers to train students' critical thinking skills (Muliani et al., 2022).

Based on the background above, the problem formulated in this research is as follows: What is the validity of the student worksheet based on critical thinking skills for Fifth class students on the properties of light, How is the practicality of the student worksheet based on critical thinking skills for Fifth class students on the material Properties of Light, How effective is the student worksheet based on critical thinking skills for fifth class students on the material Properties of Light.

This research aims to test the validity, practicality and improvement of critical thinking of fifth grade students at SD Negeri 106162 Medan Estate using student worksheet based on critical thinking skills on the properties of light.

METHOD

This type of research uses R&D research and development methods carried out at SD Negeri 106162 Medan Estate with 25 students at December 2023, where the research and development method is a research method that is very important for researchers to master to validate and develop a product. According to Sugiyono (2011: 297), this research and development method is a research method used to create and test the effectiveness of a product. To produce a product, research using needs analysis is used. The R&D research method in this study is needed to test the effectiveness of the product that the researcher produces in the form of student worksheet in order to improve critical thinking skills on the properties of light using the ADDIE development model.

The ADDIE development model consists of 5 steps that can be easily understood and can be implemented to develop a development product, for example: Textbooks, Learning Models, Learning Videos, Multimedia, and others (Tegeh, 2014). Based on this, research into the development of student worksheet based on critical thinking is suitable for using the ADDIE model. There are 5 steps

in the ADDIE model, namely: analysis, design, development, implementation and evaluation.

In this research, the stages carried out in Analysis are 1) identifying learning problems, goals and objectives, 2) understanding the needs, characteristics and context of students, and 3) carrying out task analysis to understand the skills and knowledge required. At the Design stage, there are activities in the form of 1) developing detailed instructional strategies and materials, 2) creating learning objectives, assessment tools, exercises and content frameworks, 3) planning the structure and sequence of learning content. At the Development stage, activities consist of 1) creating and collecting content and learning materials, 2) developing teaching materials, 3) conducting trials on the materials to ensure that the materials achieve the desired results. At the Implementation stage, activities consist of 1) carrying out validation of teaching materials, 2) delivering or distributing learning materials to students through teaching materials, 3) facilitating the learning process through developed teaching materials. Next, at the Evaluation stage, activities consist of 1) assessing the effectiveness of instructional design and learning outcomes, and 2) making revisions and improvements based on evaluation data.

Student worksheet validation testing is carried out by providing a validation sheet. This validation sheet is given to three validators, namely material expert validation and media expert validation. The validation assessment was carried out twice on validator II. Meanwhile, in the second assessment after revision, validator II provided several improvements in order to perfect the student worksheet. Category of the validation result follows criteria in table 1.

Table 1. Practical Criteria for student worksheet

Percent Score Interval	Category
p > 80	Effective
60 < p < 80	Quite effective
40 < p < 60	Fairly effective
p	Not effective

RESULT AND DISCUSSION

Validation Test Result of Student Worksheet

Product Validation Results After the product has been developed, the next step is to carry out validation testing on the product which aims to find out and test the suitability of the student worksheet product before it is tested on students. Apart from that, validation testing is also expected to provide input in the form of criticism and suggestions that are useful in improving the product will be used. validation result of student worksheet shows in table 2.

Table 2. Validation Result of Student Worksheet

Validator	Total score	Each validator average	Validator Average	Category
I	70	85	86	Highly valid
II	75	93		
III	60	82		

Based on this data, it can be seen

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that the average validation is 86 so that the student worksheet based on critical thinking skills is included in the very valid category criteria.

Practicality Test Result of Student Worksheet

The next stage is the stage of testing the product with students. The core activity begins with researchers distributing student worksheet to students. The next stage of learning is carried out by following the critical thinking steps contained in the student worksheet. The practicality test of student worksheet critical thinking skills aims to determine the benefits and convenience that students can experience in working on it. The practicality test is carried out using a student response questionnaire sheet which has previously been validated by the supervisor. Practicality data was obtained through student response questionnaire sheets and educator response questionnaire sheets.

The questionnaire data obtained by each student is then averaged to produce an average score per person. Next, the average obtained per person is added up and distributed by 25 according to the number of students. Based on the results of the questionnaire analysis, educators' responses to student worksheet obtained an average of 88.8 in the very practical category, while analysis of student responses was 82.11% in the very practical category.

From the analysis results of the two questionnaires, namely the teacher response questionnaire and the student response questionnaire, an average of 85.49 was obtained in the very practical category. Thus it can be concluded that the teaching materials that have been used in the form of student worksheet are very practical to use and help and make it easier for students in the learning process.

Effectiveness Test Result of Student Worksheet

The effectiveness test was carried out at the first and third meetings by giving pretest and posttest questions containing critical thinking ability tests. The critical thinking test on joint decision material is given in the form of 10 essay questions. There were 25 students who took the pretest and posttest.

In the pretest, it is known to have a minimum score of 20 and a maximum score of 70. Meanwhile, in the posttest it is at a minimum score of 50 and a maximum of 100. The average obtained during the pretest was 48.4, while the average score obtained in the posttest was 81. learners. Based on the percentage values obtained, it can be seen that the results of increasing students' critical thinking skills are at a percentage of 65% in the Quite Effective category.

Student Worksheet based on Critical Thinking Skills is Declared as Valid Learning Media

Validation of student worksheet based on critical thinking skills is used to determine the extent to which worksheet based on critical thinking skills can be used and has useful qualities in order to create an innovative student worksheet based on Critical Thinking Skills. Based on

the results obtained from experts, namely material experts and media experts, the overall category was "Very Suitable for use".

The validity of the instruments includes content and construct validity. The validity aims to assess the relevance of the test to the material being measured or to be collected. The construct validity test is a framework for a concept which can be interpreted as a type of validity which is related to the ability or measuring instrument to measure an object using the concept it measures.

The validation results for student worksheet based on Critical Thinking Skills given by material experts were 92.8% with the Very Appropriate category. This value was obtained from various aspects, namely from the completeness of the material, the image presentation aspect, and student involvement. The results of the validation of student worksheet products based on critical thinking skills given by media experts obtained results of 83% in the category "Very Appropriate. This value can be seen from various assessment aspects including aspects of coloring, illustrations, use of variations of letters and word usage, feasibility of student worksheet based on critical thinking skills in learning Result of validation of student worksheet products based on critical thinking skills given by linguists obtained a result of 80% in the "Very Appropriate" category. This value was seen from various aspects including the communicative aspect of language, the use of background colors and displaying a good center of view.

Based on the results obtained from each expert, it can be concluded that the student worksheet based on critical thinking skills that was developed is categorized as very valid with an average of 85% from both validators, so it is very suitable to be tested on students of elementary school.

This is in line with Rosa's (2013) research, the results of which show that the quality of the student worksheet in terms of the appropriateness aspect, language aspect, presentation aspect and graphic aspect is overall "good" and "suitable for use in physics learning.

Student Worksheet based on Critical Thinking Skills is Declared as Practical Learning Media

The results of the student worksheet based on critical thinking skills were stated to be very practical, obtained through a questionnaire instrument which was distributed to student and educator respondents. Questionnaires were distributed to 21 fifth class student respondents. Respondents' responses regarding student worksheet based on critical thinking skills obtained a percentage assessment result of 82.11% in the Very Practical category. Respondents provided an assessment of the 9 indicators contained in the questionnaire sheet after respondents used the student worksheet based on krıtıs thinking skills in learning. As for the educators' responses, the results obtained were in the very good category so that they were in the very practical category because the dominant responses given by the educators were in the Very Practical interval. Critical thinking is able

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to improve critical thinking skills because there are materials, images, information and questions. The types of questions contained in the student worksheet are based on critical thinking skills, namely imaginative and open questions.

The practicality of student worksheet based on critical thinking skills can be seen from the use of the product itself, for example teachers, students and other users do not experience difficulties and the material contained in the student worksheet based on critical thinking skills is in accordance with the applicable curriculum. Student worksheet based on critical thinking skills is said to be practical if students can easily use the product and can improve critical thinking skills. This is in accordance with Arikunto's (2010) statement which means that practicality in educational evaluation is the convenience of evaluation instruments, both in preparing them, using them to interpret the results, and the ease of using them.

A good student worksheet is an interesting student worksheet, the material is easy to understand, helps students' understanding in learning and can improve students' thinking abilities (Sari et al., 2019; Basri et al., 2020). Student worksheet is teaching material that can be used to facilitate students so they can easily learn the material. Apart from that, student worksheet based on critical thinking skills can also be used by teachers to train students' critical thinking skills (Muliani et al., 2022).

Student Worksheet Based on Critical Thinking Skills are declared Effective Learning Media

The results of the Pretest-Posttest test show that student learning outcomes have increased before and after using the student worksheet based on critical thinking skills. The score obtained before using the student worksheet based on critical thinking skills was 48.4 and after using the student worksheet based on critical thinking skills, it increased to an average score of 48.4. average 81 There is a difference in the average score before using the student worksheet based on critical thinking skills and after using the student worksheet based on critical thinking skills.

So, the difference in the average score before and after using the student worksheet product based on critical thinking skills is 32.6. The increase in grades obtained by students is of course from students' critical thinking abilities in receiving material and working on questions contained in the student worksheet as a form of evaluation to determine the extent of students' critical thinking abilities. student worksheet based on critical thinking skills used in learning is said to be effective in improving students' critical thinking. Furthermore, to determine effectiveness, a gain value of 0.65 was obtained with a percentage of 65% so that the product developed was included in the effective category.

Based on this description, student worksheet based on critical thinking skills for students that have been developed and tested can improve students' critical thinking skills. Matindas (2010) states that critical thinking is a mental activity carried out to evaluate the truth of a statement.

Generally, the evaluation ends with a decision to accept. deny, or doubt the truth of a statement. According to Jacob & Sam (2008) there are four stages in the critical thinking process, namely (1) classification, where students formulate problems clearly and precisely, (2) Assessment, namely the stage where students find important questions in the problem, (3) Inference, namely the stage where students find important questions in the problem and (4) Strategy, namely the stage where students think openly in solving problems. Through critical thinking, everyone can improve their reasoning ability in dealing with everyday problems. Based on the results of data analysis, the average pretest score was 28 and posttest 79, with an N gain of 0.75, which indicates an increase in critical thinking ability.

Students Comprehension in The Topic of Properties of Light

Before implementing the student worksheet Before implementing the student worksheet based on critical thinking skills on the properties of light, a pre-test was carried out to measure students' initial understanding. The results of data analysis show that students' understanding of the material on the properties of light before implementing the student worksheet was still relatively low. The average student score on the pre-test only reached 50%, indicating that most students had a limited understanding of basic concepts in the properties of light.

Students' low understanding of the properties of light before implementing the student worksheet can be caused by several factors. First, the material on the properties of light may be abstract and complex material for students. Concepts like refraction, reflection are difficult to understand without proper help. In addition, the learning methods used before implementing the student worksheet may be less effective in facilitating student understanding.

In this context, implementing student worksheet based on critical thinking skills can be an effective solution. Worksheets are designed to encourage students to think critically, ask questions, and apply concepts in relevant contexts. In this way, student worksheet can help students build a deeper understanding of the properties of light. With the expected increase in student comprehension after implementing the student worksheet, it is hoped that students will be able to relate concepts in the properties of light to everyday phenomena and apply critical thinking skills in solving problems related to light.

It is necessary to change the science learning method towards learning based on critical thinking skills and it requires interesting, easy, useful and effective worksheet that can activate students. At the school, teachers have not used certain learning media to teach material about the properties of light. It is felt that having student worksheet can help students understand the concepts of the material presented more easily. To obtain learning media that can make things easier for students student worksheet can be created using certain approaches and methods.

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Student worksheet with the guided inquiry method can help students understand the learning material more easily and can provide direct learning experiences to students.

This critical thinking skills-based student worksheet can be used as a learning medium to support students' learning activities. The selection of guided critical thinking-based skills in developing student worksheet is based on the benefits and advantages of learning with critical thinking-based skills, namely that it can make students involved in critical thinking so that they develop intellectual skills, think critically, and are able to solve problems scientifically (Haviz et al., 2020). Critical thinking is a directed and clear process used in mental activities such as solving problems, making decisions, persuading, analyzing assumptions and conducting scientific research (Marudut et al., 2020).

Apart from that, learning using critical thinking-based skills is very effective in improving students' cognitive learning outcomes and influences students' scientific attitudes and academic achievements as well as students' learning outcomes. Student worksheet based on critical thinking skills has been proven to be useful in training students' thinking skills because this is an important part of cognitive skills based on constructivist learning theory. The constructivist view makes students gain new knowledge from the old knowledge they have (Mardhatillah et al., 2020). Through the student worksheet that has been developed, students can express ideas, express opinions in criticizing problems, be actively involved and take control to solve the problems they face (Amalia et al., 2022; Danil et al., 2023; Sumarni & Kadarwati, 2020) .

When conducting research at school regarding the implementation of the student worksheet in the topic of properties of light, students may face several obstacles. Some obstacles that students may experience in applying the properties of light, 1) the properties of light can involve abstract and complex concepts. Students may face difficulties in understanding concepts like refraction, reflection and others. Lack of understanding of these concepts can hinder students' ability to apply and explain observed light phenomena, 2) Implementation of the properties of light often involves observation and analysis of data. Students experience difficulty in carefully observing observed light phenomena, measuring accurately, or analyzing the data obtained. This lack of observation and analysis skills can hinder students' ability to understand and interpret the results of the experiments or observations they make, and 3) the students who are less interested or less motivated in the material on the properties of light experience problems in its application. Lack of interest or motivation can reduce students' involvement in research activities and reduce their efforts to understand and explain the concepts of the properties of light.

CONCLUSION

This research aims to test the validity,

practicality and improvement of critical thinking of fifth grade students at SD Negeri 106162 Medan Estate using Student Worksheet based on critical thinking skills on the properties of light. Based on the results of this research, it can be concluded that student worksheet based on critical thinking skills can be used as teaching material in student learning..

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