The Development of Science Process Skills Based on Science Student Worksheets to Improve Students' Critical Thinking Skills on Single Substance and Mixed Substances

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Abstract. This research is based on the use of Student Worksheets and the learning process that has not developed science process skills. This research is a development research through 4D model by Thiagarajan. This study aims to determine the feasibility of Science Student Worksheets based on Science Process Skills (KPS) to improve students' critical thinking skills in science learning. The reason for this research is that science learning outcomes are still low and science learning tends to only use printed teaching materials. The results showed that the results of material expert validation and media expert validation were included in very good criteria and were declared very valid and feasible to use. Science Student Worksheets based on Science Process Skills are said to be effective in learning with the assumption that students' science scores are higher when using Science Student Worksheets.

Keywords : Science Process Skills, Critical Thinking Skills

1 Introduction

The rapid development of science today produces many concepts that students must learn through learning, while teachers are no longer possible to teach many concepts to students. Learning today is the need to develop learning that is adapted to advances in science and technology so that it can be a solution to problems related to technology and science· Currently, education demands human resources to have critical thinking skills. Critical thinking is part of a complex or high-level thinking pattern that is convergent. The implementation of the learning process that takes place in the classroom is only limited to memorizing information. They are not required to conduct experiments and relate the material to situations in everyday life.

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Science process skills are skills that scientists use in forming knowledge in solving problems and formulating results. Student worksheets are also part of teaching materials that can develop thinking skills, ask questions, and answer questions, make connections and assess student learning outcomes. Science process skills are needed because they are preparation and practice in dealing with the realities of life in society because students are trained to think logically in solving problems. In developing science process skills, children must be creative in order to be able to learn science at a higher level in a short time.[1]

In learning science, students should not only learn products, but there must be some students whose learning outcomes are still low and do not pay attention when the teacher explains. In addition, many students do not understand the existing subject matter because there are too many materials and only use books as a learning resource. Problems that occur in the field indicate the low learning outcomes of students in science learning. Learning activities carried out by teachers always use learning media in the form of printed teaching materials. The student worksheets themselves are very helpful for students to solve various problems because the student worksheets used contain a lot of practice questions, but for experiments they do not show scientific process skills and critical thinking because the student worksheets used only contain a variety of questions. kinds of questions for assignments. For self-experiment, the student worksheets that are often used are less helpful. For experimental activities there are no columns or orders to formulate hypotheses, or to write conclusions. So that teachers sometimes still use additional books or additional media, especially in material that conducts experiments. This is the background of the author to examine student worksheets on science subjects. During the preliminary survey activities conducted by researchers at SDN 158468 Lumut 5, it showed that the critical thinking skills of high-grade students in science subjects tended to be lower.

In learning science, students should not only learn products, but must learn about aspects of process, attitude and technology so that students really understand science as a whole. But in reality, teaching is the transfer of knowledge from teachers to students. So it is not surprising why many teachers teach by means of lectures, because for them science is a collection of knowledge that must be transferred to students[2]. Currently, education demands human resources to have critical thinking skills. Critical thinking is part of a complex or high-level thinking pattern that is convergent. Critical thinking is a cognitive activity related to the use of reason. Learning to think critically means using mental processes, such as paying attention, categorizing, selecting, and judging/deciding. Constructivism has influenced many studies of misconceptions and alternative conceptions in the field of science and now science has shown a shift that emphasizes teaching and learning processes and research methods that emphasize the concept that in learning a person contracts his knowledge.

Critical thinking skills are students' ability to analyze arguments, make conclusions using reasoning, assess or evaluate, and make decisions or problem solving. Critical thinking is a process of making reasoned decisions based on the consideration of available evidence, analyzing and evaluating arguments from various points of view [3]. Students form their own knowledge actively through interaction with their environment, because conceptual

development is the result of the interaction between existing concepts and new experiences. Therefore, a process approach can provide opportunities for students to participate in the discovery process or develop a concept as a process skill. Thus a learning process is not only a transfer of knowledge.

2 Method

This research was conducted at SD Negeri 158468 Lumut 5, Lumut District, Central Tapanuli Regency, North Sumatra Province. The reason for choosing the location of this research is because there is no available Student Worksheet based on Science Process Skills. the research carried out is included in the type of quantitative description research with*research and development*methods, namely the process or method used to validate product development [4]. The learning device development model used in this research is the 4-D Thiagarajan model, namely Define, Design, Develop, and Disseminate. The definition stage includes the initial analysis stage (front-end analysis), student analysis (learner analysis), task analysis (task analysis), concept analysis, and formulating learning objectives (specifying instructional objectives). The design stage is carried out by designing a Student Worksheet model based on Science Process Skills. At this stage, the preparation of research instruments was also carried out. The development stage (Develop) is carried out by implementing learning tools and instruments that have been validated. The dissemination stage is the stage of disseminating the development product. This data collection uses a questionnaire sheet and a student worksheet validation sheet.

3 Results and discussion

a. Material expert validation data analysis

The results of the validation in the form of an assessment score on aspects of the learning material which include the feasibility of content, quality of presentation, comments and suggestions for improvement and conclusions can be seen in table 1.

Table 1. LKPD science assessment score based on science process skills

No.	Indicator	Total Score	Mean Score	Assessment Results
1.	Content Feasibility Aspect	44	3.67	Very Valid
2.	Language Feasibility Aspect	45	3.75	Very Valid
3.	Presentation Feasibility Aspect	37	3.36	Valid
4.	Science Process Skills Assessment	53	3.80	Very Valid
Total		179	3.65	Very Valid

The assessment of the material experts on the Science student worksheets based on the science process skills table above is based on four aspects, namely, content feasibility aspects, language feasibility aspects, presentation feasibility aspects and science process skills assessment. The table shows the average score of 3.6 on the content feasibility aspect, 3.7 on the language feasibility aspect, 3.3 on the presentation feasibility aspect, and 3.8 on the science process skills assessment. Overall, these aspects are in the "very valid" category, which means that the use of Science Student Worksheets based on science process skills meets the needs of students. Thus, Science student worksheets based on science process skills can be tested in the field with revisions. The results of the assessment of learning materials on the basic competence of single substances and mixed substances show some comments and suggestions that are not conceptual errors and can be corrected through revision.

b. Data analysis of media expert validation results

The results of the assessment of learning media showed some comments and suggestions that were not conceptual errors and could be corrected through revision. Science student worksheets based on science process skills by media experts were declared eligible for field trials with revisions in the missing sections. The results of the media expert validation can be seen in table 2.

Table 2. Results of assessment by media experts on KPS-based Science

No.	Indicator	Mean Score	Criteria
1.	Student Worksheet Size	4.0	Very Valid
2.	Student Worksheet Cover Design	3.5	Valid
3.	Student Worksheet Content Design	3.7	Very Valid

c. Analysis of the effectiveness of student learning outcomes in trial II

The test results obtained by researchers were analyzed to see students' mastery in learning trial II. Criteria: 0% Family Planning < 70% of students have not finished studying, 70% Family Planning 100% of students have finished studying. Based on the criteria for mastery learning trial II which is based on the ability of students, it is classified in the criteria for completion, including:

Table 3. Results of pre-test and post-test Trial II

Pre-test Result of Trial II		Post-test Result of Trial II	
Average	60	Average	75.44
PKK	34 %	PKK	88 %

Based on the data of individual learning completeness according to the results of the student's ability, it is known that there are 17 students who are "incomplete" and 8 students are "completed". Meanwhile, based on the data on individual learning provisions according to the results of students' abilities, it is known that there are three students who are "unfinished" and there are 22 students who are "completed". Based on the classical learning completeness data above, there are 88% of students who have achieved KB 70%. Based on the data on student learning outcomes in the second trial, it can be classified into complete and incomplete levels. For that can be seen in the following table.

Table 4. Completeness data on learning outcomes

No	Range Numbers	Frequency	Percentage	Criteria
1	70-100	22	88 %	Completed
2	0-69	3	12 %	Unfinished
Total		25	100%	

Based on the results of the data analysis in the table, it was obtained that the student learning outcomes in the second trial were 88% or 22 students were declared complete. While those who have not completed there are 12% or 3 people. After the students' mastery in individual and classical learning is analyzed, the results of the pretest and posttest are calculated with a gain score to see an increase in the value and effectiveness of the student worksheets that were developed between before and after using the gain score. Based on the gain score, the results obtained are 0.38. The gain score in the second trial is still classified as moderate. Overall, the results of the second trial data analysis showed that the science process skill-based science student worksheets had met the effective criteria. Thus it is known that the results of the second trial are better than the first trial. This is because the learning media used in the second trial is a revised learning media from the revision I learning media, so it can be concluded that the science student worksheets are based on science process skills to improve The developed students' critical thinking skills have been effective.

4 Discussion

One of the objectives obtained from the development of learning tools in this study is to increase students' critical thinking skills. Zahroh & Yuliani (2021) in their research stated that student worksheets can construct thoughts and improve students' abilities to analyze and evaluate lesson concepts in solving problems. When students have mastered the ability to analyze and evaluate then they can be said to have been able to think critically [[5]]. This is also in line with the research of Sari et al (2019) in their research stating that student worksheets can be an alternative support for practicing critical thinking skills in students, so students can easily understand a problem encountered in everyday life and then analyze the problem. by identifying problems, looking for clear and accurate references to answer problems that occur. [[6]]

Based on the results of the analysis of the improvement of students' critical thinking skills in the first and second trials, it showed that the children's critical thinking skills increased as seen from the students' learning outcomes before using the student worksheets and after using the student worksheets. The increase in learning outcomes can be seen by the percentage of learning completeness in the first trial which is 76% and 88% in the second trial with a very good category. The increase in learning outcomes can also be seen from the gain score in trial 1 only got 0.38 medium category with an average pretest of 48 and posttest of 70, so it is necessary to implement a trial design II. In the second trial, the gain score was 0.49 in the medium category with an average pretest of 60 and posttest of 75. So it was concluded that students' thinking skills increased with an afternoon gain of 0.49 in the medium category.

Based on the exposure and data analysis of critical thinking skills above, it is known that learning science student worksheets based on science process skills encourages students to be able to communicate things that have been understood to build new knowledge through finding answers to a problem.

5 Conclusion

The conclusion in this study is based on the findings of the research data, the systematic presentation is carried out by taking into account the research objectives that have been formulated. The conclusions include: Based on the results of the validation of material experts 3.65 (very valid) and media experts 3.78 (very valid), the science student worksheets developed are included in very good criteria and are declared valid and feasible to use. Based on the students' critical thinking mastery data before using the science student worksheets, an average score of 60.72 was obtained, while after using the students' critical thinking mastery data obtained an average of 81.04 students' critical thinking mastery data with a *gain score* of 0.52 into the medium category. . Based on these data, science student worksheets based on science process skills were declared effective for use in learning. Children's critical thinking ability increases as seen from student learning outcomes before using student worksheets and after using LKPD. The increase in learning outcomes can be seen by the percentage of learning

completeness in trial 1 which is 72% and 88% in trial II with a very good category. The increase in learning outcomes can also be seen from the *gain score* in the first trial which only got 0.32 categories so it was necessary to carry out the second trial design. In the second trial, a gain score of 0.52 was obtained in the medium category.

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References

[1] Rini, N. 2018. *Learning Models to Improve Argumentation Skills, Science Process Skills, Concept Understanding, and Strengthen Student Retention. Dissertation.* Surabaya: State University of Surabaya.

[2] Firdaus, M., & Wilujeng, I. (2018). The development of guided inquiry worksheets to improve critical thinking skills and student learning outcomes. *Journal of Science Education Innovation*, *4*(1), 26–40. https://doi.org/10.21831/jipi.v4i1.5574

[3] Septiarini, A., & Puspasari, D. (2020). Development of HOTS-Based LKPD and Guided Inquiry in the Subjects of Automating Public Relations Governance and Protocol Class XII OTKP Odd Semester at SMKN 10 Surabaya. *Journal of Office Administration Education (JPAP)*, *8*(1), 9–21. https://journal.unesa.ac.id/index.php/jpap

[4] Sugiyono. (2019). *Qualitative Quantitative Research Methods and R & D*, Bandung: Alfabeta.

[5] Zahroh, DA, & Yuliani. (2021). Development of scientific literacy-based E-LKPD to train students' critical thinking skills on growth and development materials. *Journal of Bio Edu*, *10*(3), 605–616.

[6] Sari, K., Sujarwanta, A., & Santoso, H. (2019). Development of Student Activity Sheets (LKPD) for Biology Learning Based on Critical Thinking Skills in Class VII MTs Ecosystem Materials. *Journal of Lentera Pendidikan Research Center LPPM UM METRO*, *4*(1), 63–72. https://ojs.ummetro.ac.id/index.php/lentera/article/view/1092