

## The Implementation of Student Worksheet Based on STEM (Science, Technology, Engineering, Mathematics) and Local Wisdom to Improve of Critical Thinking Ability of Fourth Grade Students

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### Abstract

The aim of this research is to analyze the effectiveness of students worksheet to improve of critical thinking ability of fourth grade student's of SD N 5 Parakan Kauman based on STEM (Science, Technology, Engineering, Mathematics) and local wisdom. This research adopt the procedure of research and development that oriented in 4D model (Define, Design, Developed, and Disseminate). The research design used was one groups pretest-posttest design with the member of subject were 24 students. The research instrument used observation sheet, interview sheet, validity test, written test (pretest and posttest), and also questionnaire. The result of the research showed that students worksheet included in the effective enough category, which based on the calculation of N-Gain score was 62.7809 or 62.8 %, with a minimum score is 57.14 % and a maximum score 66.67 %. These scores showed the improvement of student thinking in solving problem aspect, with good and very good categories. The result of the teacher respondent is 67, it is in interesting category and the student respondent got 84 in average score, it is in very interesting category. It can be concluded that the implementation of student worksheet in STEM basic and local wisdom can be implemented in teaching learning activities, it also improve the ability of students' critical thinking.

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## INTRODUCTION

Education is one of the culture manifest that dynamic and progressive (Ikman *et al*, 2016). The most important aspect in developing country is education. The up and down of the nation can be seen from the education quality (Rahayu, 2017). The existence of 2013 curriculum is the effort of the government in improving the education in Indonesia, because the developing era that grow and grow need human resource that competence in all of the aspect (Utami *et al*, 2018). Education is not the curriculum that consist of some subject, because actually the subject is the knowledge that be adopted from life aspects (Kusuma, 2018). Education takes apart in preparing human resource that can think independently, creative and critic, because education is the basic source for developed qualitatively human (Dewi, H. R. *et al*, 2017). The way to improve creativity is the implementation of learning models to create creatively ideas and relate to the curriculum 2013 (Furi *et al*, 2018).

Based on Hanover research (2011) as khoiri (2017) stated that 21<sup>st</sup> century needs the learning that based on integrated technologies, one of them is STEM (Science, Technology, Engineering Mathematics) that nowadays be trending topic in 21<sup>st</sup> century to compete globally and handle the life issues through STEM literation. According Rivai *et al*. (2018), education that integrate in STEM is the right approach in improving the quality of education. The learning process in school should be integrated with the relevant technology, so the learning process can be implemented in this community (Artobatama, 2018) and the students can connect it with the real life (Morgot *et al*, 2019). The students that study with STEM (Science, Technology, Engineering Mathematics) approach will have better multi representation skill significantly than others that without it (Mulyana, 2018).

For the next, scientist approach must be balance between the science knowledge itself through giving scientific characters and local wisdom values that the community have

(Suastra, 2010). Beside, scientific approach must be able to grow the students characteristic that more appreciate the local culture and try to survive it ( Khusniati, 2014), as well realize the important role of local wisdom to face the problems in order not to destroy the environment itself (Wibowo, 2012). It is important for school to have the subject that consist of local wisdom (Damayanti, 2013). The local wisdom values not be the obstacle in prograssing global era, but it can be the power of transformational in improving the human source quality as the asset for competitive and comparative country (Wagiran, 2012).

The real condition of SD N 5 Parakan Kauman can be seen that the score of formative test about “where I live” and sub theme “the environment of where I live” is under the minimum target criteria that has been established by the school, 75. It can be happened because of :

(1) The materials learning that related to the theme “where I live”, in sub theme “the environment of where I live” is not complete and not interesting, it can be seen in student book theme 8, in this book there is no STEM and Temanggung local wisdom, so it influences the students in learning. (2) The learning process is still dominated by the teacher, it influences the ability of the students critical thinking. (3) The learning process always focus on the text book, as the teacher of fourth grader said, that he didn’t do any inovation or developing in teaching learning or update the newest. (4) The learning materials resource just use student book or student worksheet. The number of the student worksheet or students book is not enogh for all students and the materials in this worksheet is not relevant to the students’ real life. It makes the students don’t know the newest knowledge.

One of the effort of the government in improving the education quality is developing learning materials (Bappenas, 2009). The materials should be develope in order to help the teacher presents the materials (Pangesti *et al*, 2017). One of the alternatif that can be used by the teacher in learning activity is student worksheet (Rahmatillah *et al*, 2017). The student

worksheet can be used in learning activities. This student worksheet must be related with scientific approach that consist of these activities, observing, asking, trying, reasoning, and conclusion (Putra, 2017). Up to now, student worksheet is one of the ways to help students more active in constructing their knowledge as stated in curriculum 2013 (Anggraini *et al*, 2016). Student worksheet in learning activity change teacher centered learning to student centered learning. In teacher centered learning the activities in one way interaction, where the teacher explain, dictate while the student just listen, write and follow the teacher's instruction. Vice versa, in student centered learning process, the student will make interaction between them and the teacher (Nurkhayati *et al*, 2015).

Scientific skill process has a strong relation with critical thinking. The student with the higher scientific skill process will have the higher critical thinking to (Nugraha, 2017). The competencies that must be had to face the global competition in looking for job at 21<sup>st</sup> century needs the individu that has creativity, critical thinking, independence, can work in team, informative, communicative and learning (Kivunja, 2015). The high skill is one of the skill that must be prepared for the student to produce the quality human resource (Agnafia, 2019). Some researchers said that there are two indicators in the ability to think. They are critical thinking and creative thinking (Sari *et al*, 2018). The ability of critical thinking is the ability to identify, analyze, and solve the problem creatively and logic, to get the right decision (Syarifah *et al*, 2018). The ability of critical thinking can be described as active process, reflective, and logic that related to determine the thing that must be done (Susantini *et al*, 2012). Some of the formal definition of critical thinking describe critical thinking as an application that be got from the skill of the high rational think, like analyze, sintesis, knowing the problem, and solving the problem, inference and evolution (Belecina & Ocampo, 2018). The ability of critical thinking in every individu are not the same, it depends on the training that be done to improve critical think (Fakhriyah, 2014).

Because of that, it is important for the teacher to open minded that the mission of education not only transfer the materials but also teach and build the ability to be creative and critical. The teacher should give a good manner to be careful, sistematic, evaluative, analitic, flexibility and good responsive in differences ideas (Siswono, 2016).

This research is aimed to develop student worksheet based on STEM and local wisdom to improve the student ability to think critically for the fourth grade of elementary school. In this process, student worksheet contents of description of student daily life that consist of STEM and local wisdom in Temanggung regency.

## METHODS

This research is developing research that oriented to 4D model (Define, Design, Developed and Disseminate). The design in testing the product use one Group Pretest-Posttest Design. The subjects of the research are the fourth grade of SDN 5 Parakan Kauman. The procedure in this research consist of four steps, they are definition, planning, developing, and distributing.

Definition step are 1) Doing observation in the fourth grade class during learning activity, 2) Doing interview to the teacher of fourth grade SDN 5 Parakan Kauman, 3) Doing FGD (Focus Group Discussion) with all the teachers to discuss the usage of student worksheet in that school, 4) Doing documentation.

Planning step are 1) Making the material planning and the design of student worksheet, 2) Preparing the research instrument, there are validity sheet, pretest and posttest as well questioner sheet.

Developing step are 1) Making student worksheet as like the planning, 2) Doing validity test, 3) Doing limited test to know the validity, reliability, difficulty level and distinguish ruse in every items that has been tested, 4) Doing large test (pretest and posttest) and the questionnaire to the students of fourth grade SDN 5 Parakan Kauman .

Distributing step are 1) Ddistribute student worksheet product if the result of the research properly to use, but if the result of

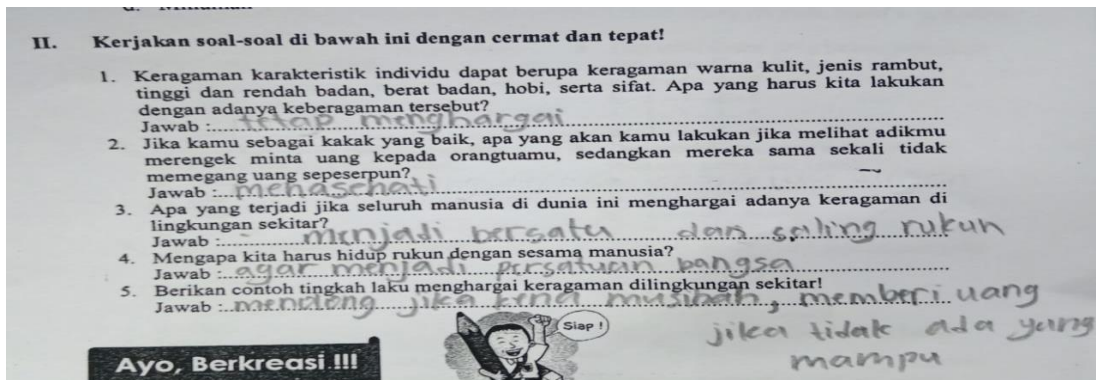
research is not effective, student worksheet product is not properly to spread out.

The data collected in this research are the data of validity test, test, and questionnaires.

**RESULTS AND DISCUSSION**

The results of thematic learning are presented in several samples of student worksheet from thematic learning including Pancasila and civic education (PPKn),

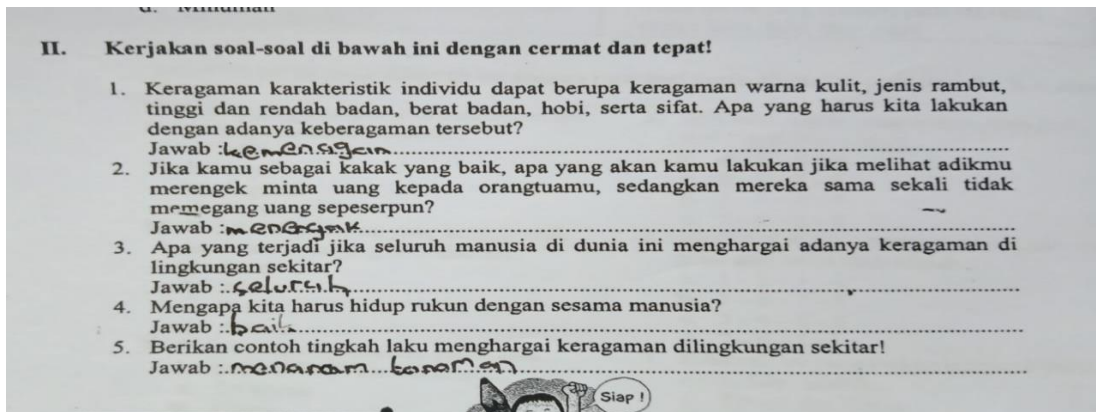
Indonesian language (BI), natural science (IPA), social science (IPS), as well as cultural arts and crafts (SBdP). The samples of students' answer in PPKn test are shown in Figure 1 and 2.



**Figure 1.** Sample of student's answer in PPKn from highest score student

The student answers correctly all the items according to the question given. She understood better in characterized the diversity

of human being, environment, and implemented good character of how to live together and respect for others.



**Figure 2.** Sample of student's answer in PPKn from lowest score student

The student have not been able to answer the question correctly. Seen from what he answered from the questions that have been provided. He does not yet understand about the

kinds of diversity around his environment and cannot apply it in a good character. While the students' result in answering the BI test are presented in Figure 3 and 4.

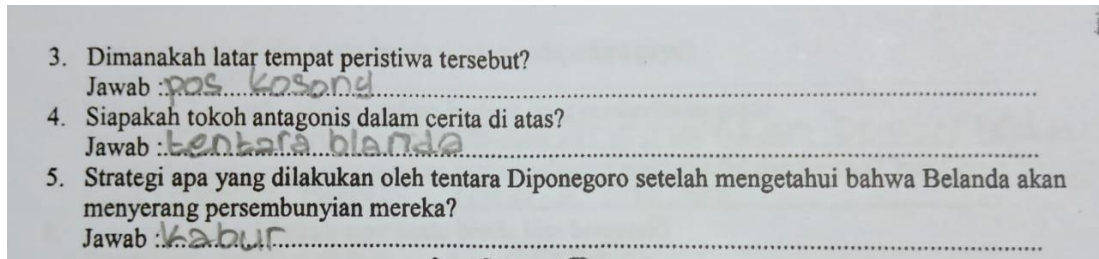


Figure 3. Sample of student’s answer in BI from highest score student

The student answers correctly all the items according to the question given. She understood about local wisdom in Temanggung regency. She can answer exactly what is asked about the history of Posong.

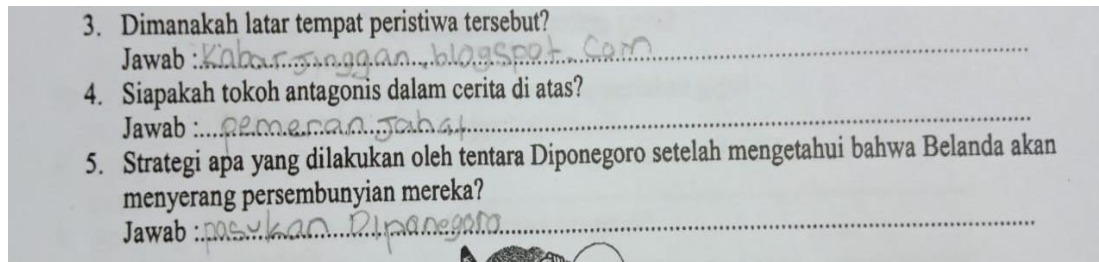


Figure 4. Sample of student’s answer in BI from lowest score student

The student have not been able to answer the question correctly. She does not yet understand about local wisdom in Temanggung regency. She did not understand what was asked in the matter, so the answer doesn't match the question asked. Students’ answers in IPA test are displayed in Figure 5 and Figure 6.

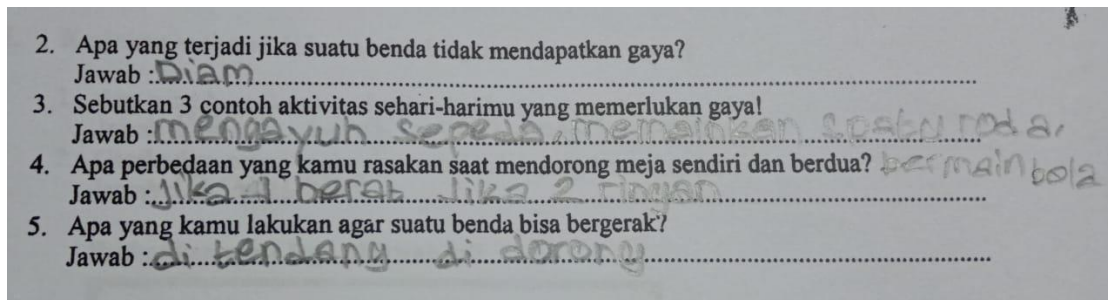


Figure 5. Sample of student’s answer in IPA from highest score student

The student answers correctly all the items according to the question given. She understood about the difference of energy and action, so he can mention and explain his daily activities.

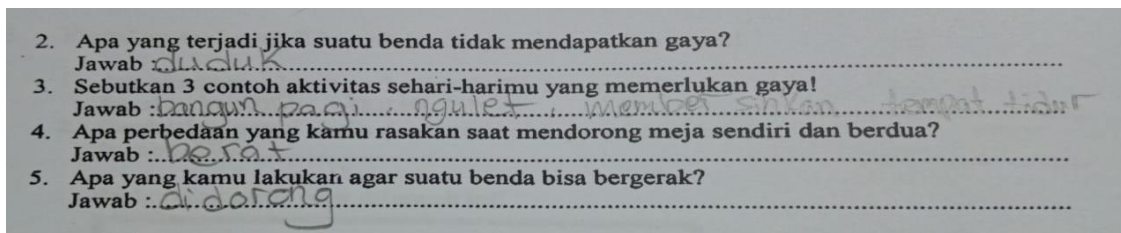


Figure 6. Sample of student’s answer in IPA from lowest score student



The student have not been able to answer the question correctly. He does not yet understand about the difference of energy and action. He cannot yet explain the effect of the

action of objects produced by an energy. In answering the IPS test, the results of students' results are as in Figure 7 and Figure 8.

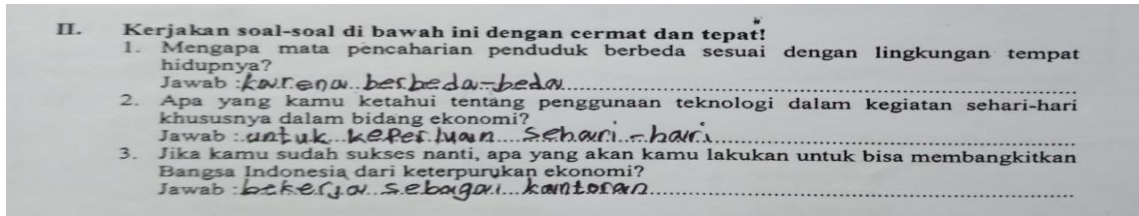


Figure 7. Sample of student's answer in IPS from highest score student

The student answers correctly all the items according to the question given. She understood about the various jobs and the current situation of Indonesia. She understood

when asked about Indonesian life at this time, and he had a desire to advance the Indonesian state from the current slump.

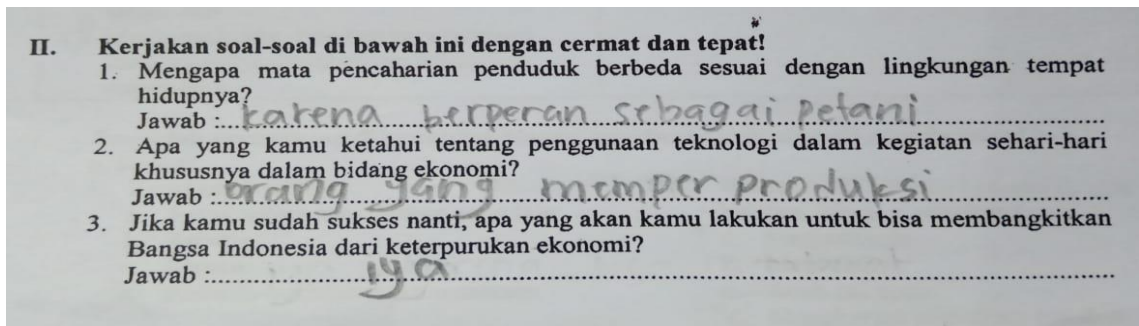


Figure 8. Sample of student's answer in IPS from lowest score student

The student have not been able to answer the question correctly. He does not yet understand about the various jobs and the current situation of Indonesia. He could not explain the natural conditions that affect the

livelihood of every human being, could not yet understand the existence of technological developments and the current state of Indonesia. In SBdP test, the students answer are performed in Figure 9 and Figure 10.

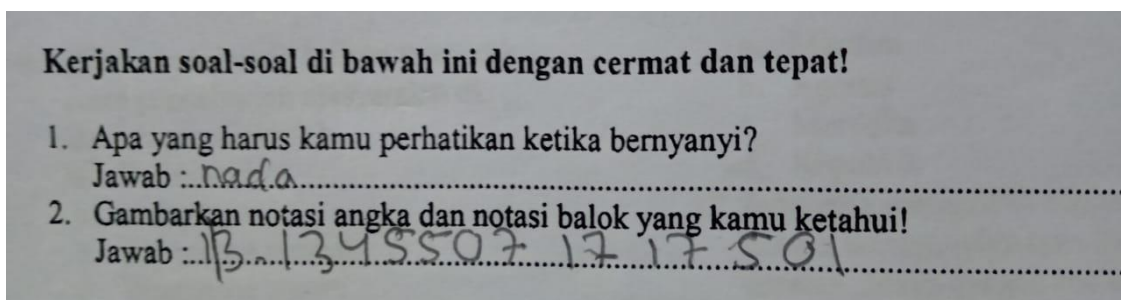
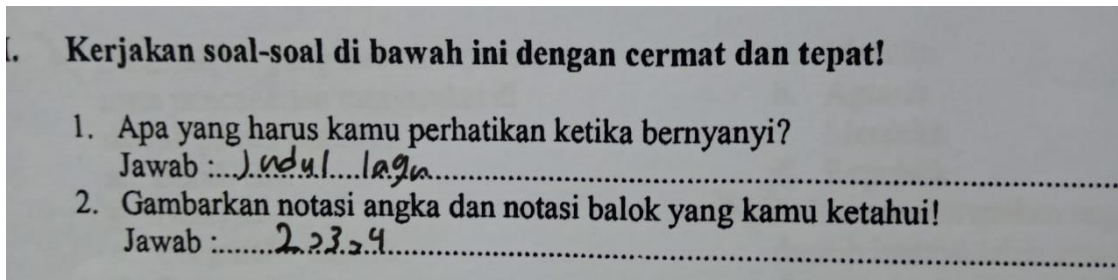


Figure 9. Sample of student's answer in SBdP from highest score student

The student answers correctly according to the question given. She understood about the singing and sign techniques, although he could

not yet fully describe the number and block notation correctly.



**Figure 10.** Sample of student’s answer in SBdP from lowest score student

From the answers above, the students answer questions by incompletely and do not answer according to the questions given. He cannot answer the question correctly and cannot describe the number notation and the block notation.

After the overall score of student work has been analyzed. Then the technic used to analyze the pretest and posttest is the N-Gain score through SPSS version 28. The results of the N-Gain score can be shown in Table 1.

**Table 1.** The result of N-Gain score

No	Subject	Pretest average	Posttest average
1	Pancasila and Civic Education	55	85
2	Indonesian Language	57	83
3	Natural Science	58	86
4	Social Science	58	82
5	Cultural Arts and Crafts	46	80
Average		62.7809	
Minimum		57.14	
Maximum		66.67	

Based on the result of N-Gain test used SPSS verse 24, show the average score for student worksheet STEM basic and local wisdom is 62.8 is effective category with N-Gain minimum score 57.14% and maximum 66.67 %. So it can be concluded that student worksheet in basic STEM and local wisdom is effective in improving the ability of critical thinking for the

student of fourth-grade SDN 5 Parakan Kauman especially in solving the problem aspect. The result of teacher and student respondent about the effectiveness of student worksheet with STEM basic and local wisdom through the questionnaire.

Based on the result of questioner test of teacher respondent of fourth grade by using score or likert scale, that the teacher interest in student worksheet that has been developed, it be shown in the score 67.1 in interesting category. So student worksheet with STEM basic and local wisdom is proper to use as main book and material for teacher to teach in teaching learning process. The result of students' respondent can be shown in Table 2.

**Table 2.** Student respondent result

Result	Score	Value	Criteria
Average	50	83.6	Very interesting
Minimum	44	73.3	Interesting
Maximum	55	91.7	Very interesting

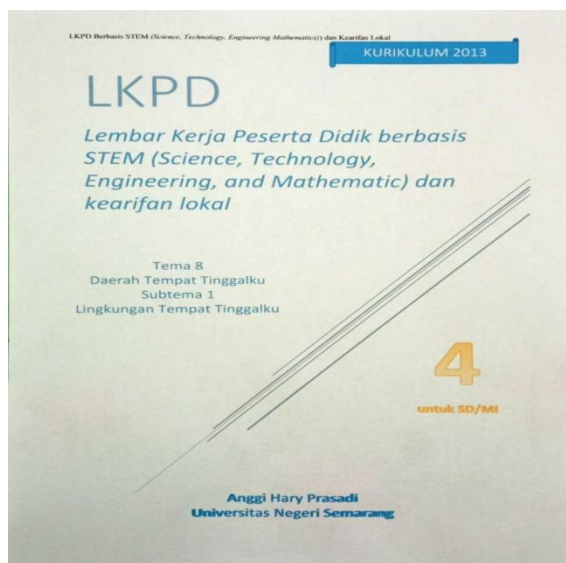
Based on the result of questionnaire to the student respondents, the data show that the students of fourth grade SDN 5 Parakan Kauman very interest in developing this student worksheet with the total score of the average is 50 that next be analyzed use likert scale with maximum score is 60, so the score is 83.6 in very interesting criteria. So, the student worksheet with STEM basic and local wisdom is proper to use as student book in learning process especially for improve their ability of critical thinking.

Student worksheet with STEM and local wisdom basic is the learning materials has been developed to improve the students' ability in critical thinking for fourth grade students. The achievement result of critical thinking level of the students is measured with written test in multiple choice and essay with the questions that related to the ability critical thinking indicators.

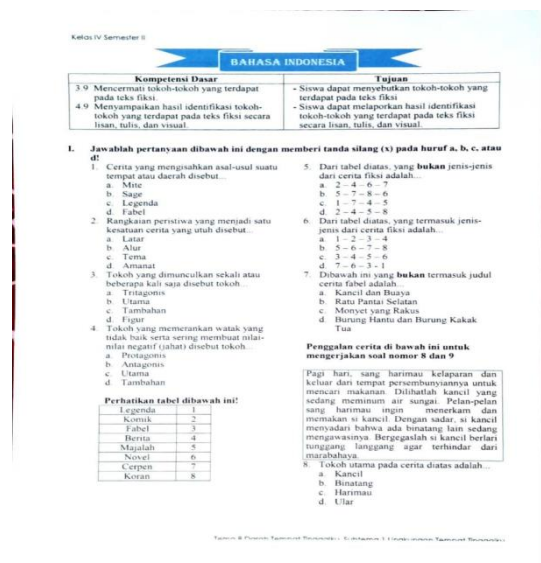
This research adopt the procedure of research and development that oriented in 4D model (Define, Design, Developed, and Disseminate). In this definition step, researchers have conducted curriculum analysis, formulated learning objectives, learner characteristics analysis, and material analysis by performing observations, interviews, and FGD (Focus Group Discussion) with teachers at SDN 5 Parakan Kauman. In planning step, researchers make product or product design. This step is done to create the teaching book according to

the outline of the contents of the pre-defined definition result. In this development step, there are two activities that are validating or assessing the feasibility of the product design by the experts and the product design trials activities on the actual subject target. The last step is dissemination. This step is do the socialization of teaching materials through a limited of distribution to teachers and students. If the research result are declared effective, then the worksheet products used must be distributed to the teaching learning process or as additional books. If the user's target response is good, then the printing has been done in large quantities and marketing so that the materials are used by a wider target.

The student worksheets that have not been validated and have been validated are presented in Figure 11.



cover



content

Figure 11. Sample of student worksheets before being validated by experts

Figure 11 and Figure 12 shows the student worksheets created by researchers before being validated by experts. It is very apparent that the worksheet is still very much lacking in the cover and contents. So it still needs to be

improved and can support student motivation in learning. Figure 7a and 7b are the result of a revised worksheet that has been validated by experts.





cover

content

Figure 12. Sample of student worksheets after validated by experts

Figure 12 about student worksheets that have been validated by experts. The researcher improves the front cover by adding images of local wisdom in the temanggung district, while also in the contents section the researcher adds learning objectives, materials, and images.

The effectiveness of student worksheet with STEM and local wisdom basic is measured with (1) The difference learning result before they are given this treatment (pretest) and after getting it (posttest), (2) There is increasing of critical thinking ability of fourth grade students. The average score in pretest show that the score that under maximum criteria is 55, while the average score in posttest is 83. From the result tells that there are differences of the learning result before the treatment and after the treatment. The score of pretest and posttest be analyzed again with N-Gain test. To know the result of the increasing students' ability critical thinking can be got from the result of pretest and posttest. It can be seen that there is increasing and differences after the treatment. The six indicators of critical thinking skill are interpretation, analysis, evaluation, inference, explanation, and self regulation that be concluded as the aspect of problem solving that has grow in the students.

The research of the student worksheet based on STEM and local wisdom basic implementation to improve the ability of critical thinking is done in SDN 5 Parakan Kauman . the research show that student worksheet has been responded well by the teacher and the students. It can be seen from the result of the questionnaire analyze for teacher and students in student worksheet with STEM and local wisdom basic like that 1 teacher said interested, 21 students said very interested and 3 student interested to it. The result of teacher respondent and students respondent about student worksheet with STEM and local wisdom basic show a very good respond. student worksheet give advantage to the teacher because nowadays student worksheet that discuss local wisdom and related with daily life is rarely. This student worksheet can be the main book, learning materials, teacher reference in teaching learning process. Beside that the material in student worksheet is clearly. The students interest in this student worksheet because the picture is interesting and not monotonous. The result of teachers respondent show 67.1 in interesting category and the students responded is 83.6 it is very interesting category.

## CONCLUSION

Based on the research that be done, we can conclude that student worksheet with STEM and local wisdom is effective to improve of critical thinking ability of fourth grade students SDN 5 Parakan Kauman.

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