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EFFECTIVENESS OF COLLABORATIVE STUDENTS WORKSHEET TO IMPROVE STUDENT'S AFFECTIVE SCIENTIFIC COLLABORATIVE AND SCIENCE PROCESS SKILLS (SPS)

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***Abstract**: The purpose of this research to analyze the effectiveness of collaborative student worksheet to improve student's affective scientific collaborative and science process skills. The effectiveness of collaborative student worksheet was evaluated by using the indicators achievement of student's affective scientific collaborative and science process skills. The collaborative student worksheet was planned to improve student's affective scientific collaborative and science process skills. This research was conducted using one group pre and post-test. The collaborative student worksheet was implemented with 70 students on state junior high school of 3 Jember, Indonesia. The result showed that there was an improvement student progress on every aspect of affective collaborative scientific in 7 times on teaching and 95.9% of students assessed themselves as being able to practice affective collaborative scientific by using collaborative student worksheet. The result showed that there was an improvement SPS indicator achievement in motion subject with n-gain average = 0.73 (high) and in simple machines subject with n-gain average <g> = 0.73 (high). The research showed that collaborative student worksheet was effective to improve student's affective scientific collaborative and science process skills (SPS).*

Key words: *affective scientific collaborative, collaborative student worksheet, science process skill*

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1. INTRODUCTION

The main purpose of science education help students understands the nature of scientific knowledge of nature (NGSS, 2014: 98). Science learning outcomes in Indonesia at this time is not in accordance with expectations of the Kurikulum 2013 (i.e. curriculum in Indonesia). It made

Indonesian have not been able to creative in the future. The research results of Trends in International Mathematics and Science Study (TIMSS) showed that the average Indonesian student science achievement scores in TIMSS 1999, 2003, and 2007 respectively are 435, 420, and 427. The score Indonesian students was ranked 32 out of 38 countries (1999), rank 37 of the 46 countries (2003), and in 2007 at the rank 35 of the 49 states, as well as the results of the study in 2011 showed a decrease in position 40 of the 42 countries (TIMSS 2011).

Indonesia's position slightly above Morocco and Ghana, but far lags behind Thailand, Malaysia, and Palestine. These achievements show the average score of students Indonesia has always been below the average score of 500, only reaching the low international benchmark, because it is only able to recognize some basic facts but not creative in communicating and linking various science topics, let alone apply the concepts in problem solving daily complex and abstract. Results of research conducted by PISA ongoing basis starting in 2003, 2009, 2012, and in 2015 PISA specifically assess collaborative problem solving skills (OECD, 2013). Permendikbud No. 54 Year 2013 concerning competency junior high school students said that the competencies that must be achieved by junior high school students through the science lesson is to have the ability of thought and follow affective and creative in the realm of the abstract and the concrete in accordance with the learned in school and other such sources. This indicates that in the learning of science students have not been skilled and creative in collaborative skills that need to be developed in major affective science learning collaborative scientific and science process skills.

Science process skills is an important skill in life science process skills such as observing, analyzing, formulating hypotheses, designing and conducting experiments, conclude and implement information is a critical skill for all men in life. Reviews these necessary skills are not only in the current school science teaching alone but are very important in the application in everyday life. Someone who will be traveling requires science process skills so as not to rain by the weather forecast. The results of reviews these predictions will be used to determine whether someone should bring an umbrella when going travelling by foot. These skills need to be taught to students so that students can use them when needed both in school and in life. These skills have been a focus in the curriculum in many countries since the 1960s (Karar, *et al.*, 2012). In Indonesia Curriculum 1994 also emphasize science process skills, especially in science learning. Science process skills need to be taught and to be part of the curriculum because it can be used as a tool to study science by conducting research and as a means to resolve problems.

Affective collaborative science is a social aspect that should be owned by the students in the learning of science that includes several aspects, namely: 1) focus on the task and participation, 2) interdependence and shared responsibility, 3) were actively involved in the discussion, 4) sharing information when conducting experiments and 5) work together in teams (franker, 2011). This indicates that in the learning of each student should focus on the task and always leads to a participation that any efforts made an impact on the others, each student feels that he depends positively and tied with among fellow members of the group with responsibility for: (1) master the teaching materials; and (2) ensuring that all members of the group was mastered. They are not going to be successful when other students are also not successful. Collaborative group work together to identify, formulate hypotheses, researching, analyzing and formulating answers task or problem found himself to be solved jointly.

Students are often attentive highly motivated individuals who have good ideas which can provide successful solutions for all parties concerned, but mostly they have no way of bringing in and developing new ideas with other students in order to improve learning and educational processes. Collaborative creativity (CC) is defined as the perspective of creativity, which is an inherently social process that promotes the creative process in the form of partnerships collaborative in completing group tasks (Miells & Littleton, 2007). Creativity involves a collaborative process of scientific creativity to generate new ideas through the results of social processes (social production process) taking into account the motivation of group interaction and efficiency in group work. (Grossen, 2008: 246) states that the collaborative creativity is required in learning to produce a new understanding by making elaboration. Collaborative creativity also shows how the potential and the balance of participation can improve the contribution of the scientific creativity. Thus the collaborative creativity plays an important role in determining the success of student learning and enhance the contribution of the scientific creativity skills (Partlow, Medeiros & Mumford, 2012: 30).

Collaborative student worksheet in learning activity is very instrumental to identify problems, explore a variety of methods, and explore alternative solutions. Various alternative methods or solutions must be analyzed and evaluated to further implement. The obtained solution also needs to verify compliance with known issues. Students are often attentive highly motivated individuals who have good ideas which can provide successful solutions for all parties concerned, but mostly they have no way of bringing in and developing new ideas with other students in order to improve learning and educational processes. Collaborative worksheet allows students to develop the ability

affective and psychomotor ability. Affective abilities in collaborative activities include: 1) focus on the task and participation, 2) interdependence and shared responsibility, 3) were actively involved in the discussion,4) sharing information when conducting experiments and 5) work together in teams (franker, 2011). In addition the worksheets are also able to enhance students' collaborative science process skills.

Collaborative education was essential for student to preparing society to engage science learning. Collaborative learning is essence the co-construction of shared understanding (Roschelle and Teasley 1995; Dillenbourg & Fischer 2007). A collaborative learning method was more emphasis on construction of meaning by students of the social process which is based on the context of learning (Bruffee, 2005; Smith & MacGregor, 1992). Collaborative is an essential activity in science learning that requires affective collaborative scientific and science process skills to solve the school and society problem. The objective of this research was to analyze effectiveness of collaborative student worksheet to improve affective collaborative scientific and science process skills. It based on profile of student progress of affective collaborative scientific, indicators achievement, self-assessment and student responses.

2. METHODOLOGY OF RESEARCH

This research is used to determine the effectiveness, self-assessment and student responses of collaborative student worksheet were developed to teach the science process skills of students in learning on state junior high school of 3 Jember, Indonesia. The collaborative student worksheet which arranged two topics i.e. motion subject and simple machines subject, were supplemented with experiment in groups. Data value of affective collaborative scientific obtained from observations by observer and self-assessment of students with indicators of affective collaborative science. Indicators of affective collaborative science includes: 1) focus on the task and participation (A1), 2) positive interdependence and shared responsibility (A2), 3) were actively involved in discussions (A3), 4) sharing of information when conducting experiments (A4) and 5) to work together in teams (A5). Affective scientific collaborative category expressed in four categories, namely: C (Complete) is the example of the value of 75-100, VE (Very Expert) is very expert with a score of 50 -74, E (Expert) is an Expert with a value of 25 -49, and NC (Not Complete) is Not Complete with grades 0-24.

Data collection was conducted by using an essay test and questionnaire method with a self-assessment sheet and learning activities response sheet. The data needed to achieve the goal is the

result of data learning outcome of science process skills.. The effectiveness of students' scientific creativity skills is determined by the n-gain <*g*>.

Normalized Gain < *g* > = (score post-test – score pre-test) / (100 – score pre-test)

The test score analyzed using average normalized gain < *g* > which is defined as the ratio of the actual average gain to the maximum possible average gain, i.e. where Sf and Si are the final (posttest) and initial (pretest) class average (Hake, 1999). Hake (1999) defined g score >0.7 as highly engaged activity to promote particular understanding; 0.7>g>0.3 as medium-engaged activity; and g<0.3 as poor-engaged activity. The self-assessment sheet and the learning activities response sheet were analyzed descriptively. Analysis of the data to answer the problem and achieve the goal of the research was done by using descriptive.

Data value of science process skills obtainable from students answered the written pre-test before the teacher introduced the collaborative student worksheet. The pre-test and pos-test consisted of eight essay questions about motion subject and eight essay questions about simple machines subject. The tests were assessed by rubric criteria and scored in a scale from 0 to 100 points (Table 2 and Table 3). All of the test questions were constructed based on achievement indicators (Table 2 and Table 3). The test was administered to a sample of 70 students selected from year-8 on state junior high school of 3 Jember, Indonesia. This research was conducted by using two groups (individual – 2 students and collaborative – 6 students) at state junior high school of 3 Jember, Indonesia. The students took science classroom during odd semester in academic year 2016/2017. The research was applied using one-group pre-posttest design (Fraenkel, *et al.*, 2009:265).

3. RESULTS OF RESEARCH

The result of this research consisted of indicator achievement, self-assessment of self-capability through observation student worksheet, and student responses about lecturer's ability to teach with collaborative student worksheet. The result showed that there was an improved indicator achievement in motion subject with average g-score = 0.73 (high-g) (Table 1) and in simple machines subject with average g-score = 0.73 (high-g) (Table 2). This score indicated that motion subject and simple machines subject pretest and posttest with collaborative student worksheet could fairly engage students to conduct science process skills. Implementation of the learning collaborative student worksheet performed to obtain an indicator achievement skill of science

process. Table 1 shows the results of achievement indicators pretest and posttest of motion subject and simple machines subject.

Table 1. Average score of affective scientific collaborative

	Average Score of Scientific Collaborative Affective											
Student Initial	**A1**	**Cr**	**A2**	**Cr**	**A3**	**Cr**	**A4**	**Cr**	**A5**	**Cr**	**SA**	**Cr**
S1	62,5	VE	62,5	VE	62,5	VE	75	C	75	C	100	C
S2	62,5	VE	62,5	VE	62,5	VE	62,5	VE	75	C	75	C
S3	100	C	100	C	100	C	100	C	100	C	100	C
S4	75	C	75	C	75	C	75	C	87,5	C	100	C
S5	100	C	100	C	100	C	100	C	100	C	100	C
S6	75	C	75	C	75	C	87,5	C	75	C	100	C
S7	75	C	87,5	C	75	C	87,5	C	87,5	C	100	C
S8	87,5	C	100	C	100	C	100	C	87,5	C	100	C
S9	75	C	75	C	75	C	75	C	75	C	100	C
S10	87,5	C	87,5	C	100	C	87,5	C	100	C	100	C
S11	100	C	100	C	100	C	100	C	100	C	100	C
S12	75	C	75	C	75	C	75	C	75	C	100	C
Average Score	81,25	C	83,33	C	83,33	C	85,42	C	86,46	C	97,92	C

A1 = Focus on the task and participation, A2 = positive interdependence and shared responsibility,
A3 = were actively involved in the discussion, A4 = sharing information while performing experiments,
A5 = work together in teams, Cr = Criterion
SA = Self-assessment, C= Complete, VE= Very Expert, E=Expert, NC=Not Complete

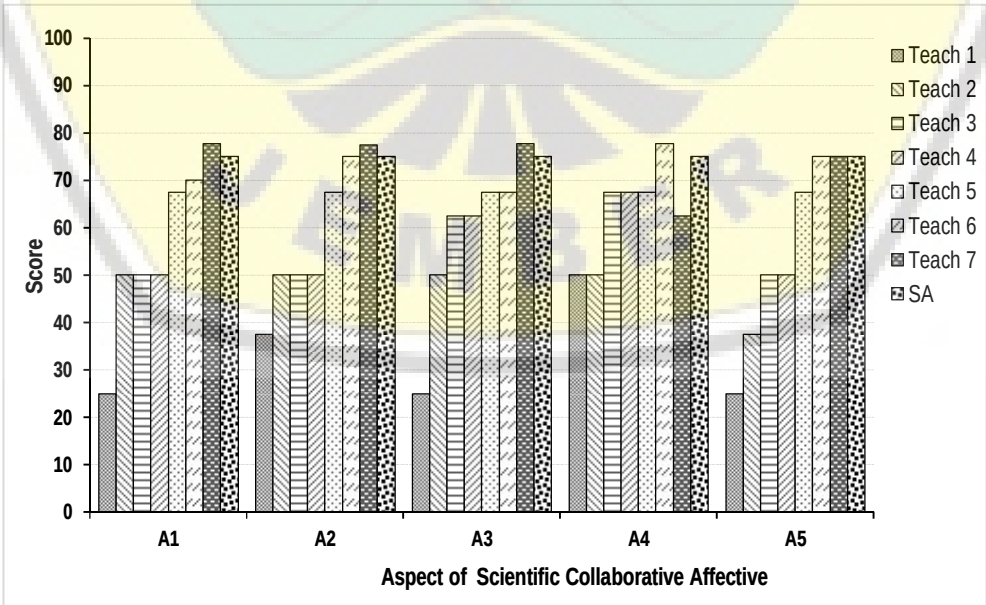

Figure 1: Progress affective students 2 enabled low to every aspect of scientific affective collaborative in class

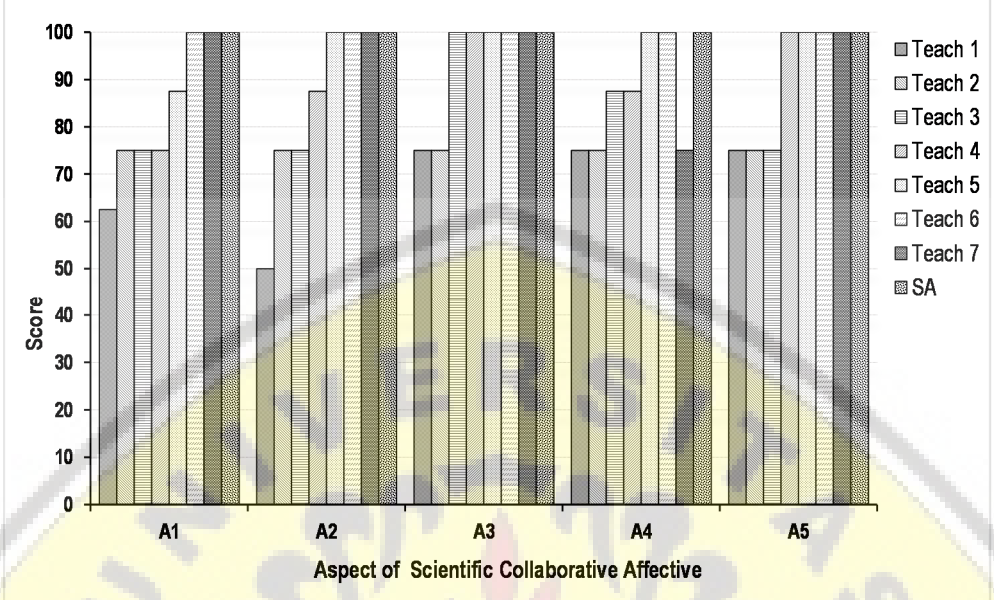

Figure 2: Progress affective students 11 enabled high to every aspect of affective collaborative scientific in class

Implementation of collaborative student worksheet in SMP 3 Jember, Indonesia can develop affective scientific collaborative in order to improve the good habits of affective scientific collaborative as shown in Figure 1 and Figure 2. Profile affective student progress is illustrated by two students with low capacity and high capability. Observation of the low and high ability students, habits of the collaborative scientific aspect remained increased. Students are accustomed to focus on tasks and participation, positive interdependence and shared responsibility, were actively involved in the discussion, sharing information while performing experiments, and work together in teams. This result indicated that collaborative student worksheet could fairly engage students to conduct affective scientific collaborative. Meanwhile, the student self-assessment of self-capability of affective scientific collaborative was higher grades.

Table 2. Student self-assessment of self-capability

Aspect	Answer Percentage (%)	
	Yes	No
I acquire opportunity to focus on tasks and participation (A1)	100	0,0
I acquire opportunity to positive interdependence and shared responsibility (A2)	97,1	2,9
I acquire opportunity to were actively involved in the discussion (A3)	92,8	7,2
I acquire opportunity to sharing information while performing experiments (A4)	90,0	10,0
I acquire opportunity helpful to work together in teams (A5)	100	0,0
Total	479,9	20,1
Total Percentage	95,9	4,1

Table 3. Achievement indicators in pre-test and post-test of motion subject

Details Performance Indicators Science Process Skills (SPS)	Score		N-Gain
	Pre-test	Post-test	
Formulating Problems	31,7	76,7	0,66
Formulate hypothesis	46,7	95,0	0,91
Identifying Variables	41,7	95,0	0,91
Formulating Operational Definition of Variables	20,0	60,0	0,50
Designing Data table	23,3	68,8	0,59
Carrying out the experiment	36,7	78,3	0,66
Analyzing the data	40,0	85,0	0,75
Drawing conclusions	38,3	91,7	0,87
Average	34,8	81,3	0,73

Table 4. Achievement indicators in pre-test and post-test of simple machines subject

Details Performance Indicators Science Process Skills (SPS)	Score		N-Gain
	Pre-test	Post-test	
Formulating Problems	36,7	80,0	0,68
Formulate hypothesis	46,7	93,3	0,88
Identifying Variables	45,5	93,3	0,88
Formulating Operational Definition of Variables	25,0	63,3	0,51
Designing Data table	26,7	73,3	0,64
Carrying out the experiment	35,0	78,3	0,67
Analyzing the data	38,3	81,7	0,70
Drawing conclusions	33,3	93,3	0,90
Average	35,9	82,0	0,73

Average indicators achievement of motion subject for Formulating Problems increased from 31,7 in pre-test to 76,7 in post-test, Formulate hypothesis increased from 46,7 in pre-test to 95,0 in post-test, Identifying Variables increased from 45,5 in pre-test to 93,3 in post-test, Formulating Operational Definition of Variables increased from 20,0 in pre-test to 60,0 in post-test, Designing Data table increased from 23,3 in pre-test to 68,8 in post-test, Carrying out the experiment increased from 36,7 in pre-test to 78,3 in post-test, Analyzing the data increased from 40,0 in pre-test to 85,0 in post-

test and Drawing conclusions increased from 38,3 in pre-test to 91,7 in post-test. Average indicators achievement of scientific creativity skill gained 34.8 to 81,3 (Table 3).

Meanwhile, average indicators achievement of simple machines subject for Formulating Problems increased from 36,7 in pre-test to 80,0 in post-test, Formulate hypothesis increased from 46,7 in pre-test to 93,3 in post-test, Identifying Variables increased from 45,5 in pre-test to 93,3 in post-test, Formulating Operational Definition of Variables increased from 25,0 in pre-test to 63,3 in post-test, Designing Data table increased from 26,7 in pre-test to 73,3 in post-test, Carrying out the experiment increased from 35,0 in pre-test to 78,3 in post-test, Analyzing the data increased from 38,3 in pre-test to 81,7 in post-test and Drawing conclusions increased from 33,3 in pre-test to 93,3 in post-test. Average indicators achievement of scientific creativity skill gained 35,9 to 82,0 (Table 4.). This indicated that both of motion subject and simple machines subject showed an improvement in test score after the collaborative student worksheet was implemented. Average achievement indicators in pre- and post-test shown in Figure 3.

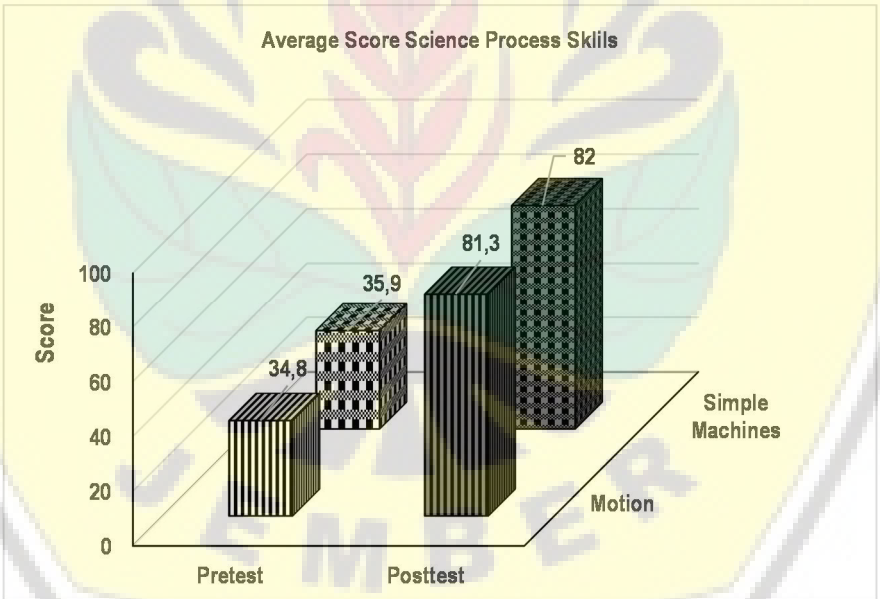

Figure 3. Average score in pretest and posttest of science process skills

Implementation of collaborative student worksheet in SMP 3 Jember, Indonesia can develop students' science process skills in order to improve the results test of science process skills as shown in Figure 3. Meanwhile, g-score of motion subject for science process skills gained 0,73 (high-g), average g-score of simple machines subject gained 0,73 (high-g). This score indicated that collaborative creativity models could fairly engage students to conduct scientific creative skills.

4. DISCUSSION

The Collaborative student worksheet (CSW) enables a suitable variety of opportunities for students to be creative in multiple ways. The Collaborative student worksheet allows student to do a research and conduct an experiment on a topic of their interest and ability under supervision of a teacher also to encourage students to participate in class in order to improve their affective scientific collaborative , i.e. focus on tasks and participation, positive interdependence and shared responsibility, were actively involved in the discussion, sharing information while performing experiments, and work together in teams and social skills e.g. interaction with friend and teacher can also increase student' interest and attention to a lesson. Using the CSW in learning, student will be able to evaluate their own learning outcomes, develop their ability of creative skills, do experimental in laboratory and helps students to understand the material by themselves.

The CSW provides a suitable variety of opportunities for students to be active in science teaching learning of motion subject and simple machines subject with scripted lesson plans on secondary school student so that has given a good value on the ability of affective, cognitive and psychomotor (Morrison, 2007; Lynch, 2009).The value of affective scientific collaborative science students acquired during the learning takes place indicators include: a focus on the task and participation, positive interdependence and shared responsibility, actively involved in discussions, share information when conducting experiments, and work together in teams. Students start accustomed to working collaboratively to solve problems motion subject and simple machines with a focus on the task and participation, positive interdependence and shared responsibility, are accustomed to working together in teams, discuss active, accustomed to sharing information and everything can be patterned well in learning to improving scientific creativity skills. Problem solving activities in learning presented in demanding students complete worksheets collaboratively, so that students have to really work together and positive interdependence with other friends to achieve a common goal. This is in accordance opinions (Miells & Littleton, 2007) that the collaborative creativity in learning emphasizes on teamwork and scientific creativity which all students need to learn to explore the views of the team together (collaborative). Collaborative learning easier for students to learn and work together, contribute ideas (ideas), share responsibility for the achievement of learning outcomes as a group or individually (Kagan, 1994; Slavin, 2006).

To develop collaborative affective science students and science process skills are more optimal, required student worksheet learning based on collaborative creativity, and students are given the freedom and scope which allows students to improve their affective scientific

collaborative and science process skills. As discussed in the previous description, collaborative affective science and science process skills supported by social constructivist learning theory and individuals focused on collaboration with others to generate knowledge and understanding (Santrock, 2013: 267). The space is believed to be able to foster the creativity of students focused on collaboration with others to produce the knowledge and understanding, through collaborative scientific activities by applying creativity. One of the strategies that are able to realize it is a creative process of learning Mumford et al., (2012: 3). This suggests that the ability of collaborative scientific activities and science process skills is determined by the process and the situation in the acquisition of data and justification of ideas.

Based on the research result to the positive responses concerning how to conduct collaborative student worksheets, students found that the collaborative student worksheets was helpful in helping them to learn how to apply scientific creativity in science teaching together with collaborative creativity. This was in line with studies from (Aktamis & Ergin, 2008: Lynch, et al. 2009) and (Astutik, et. al., 2016), (Grossen, 2008: 248) that indicated positive views of students in science teaching who received science learning in secondary school.

5. CONCLUSIONS

The results showed that the collaborative student worksheets can improve affective scientific collaborative and science process skills. Aspect of affective scientific collaborative consisted of: focus on tasks and participation, positive interdependence and shared responsibility, were actively involved in the discussion, sharing information while performing experiments, and work together in teams and indicators skills of science process, namely: the formulating problems, formulate hypothesis, identifying variables, formulating operational definition of variables, designing data table, carrying out the experiment, Analyzing the data and drawing conclusions. Improved indicators of affective scientific collaborative showed by Profile affective student progress and self-assessment of students toward mastery aspects of affective scientific collaborative obtained high value as indicated by the positive response (95.9%) stated that students can undertake aspects in affective scientific collaborative. Indicators of science process skills demonstrated by the increase in the value of the pre-test to post-test on the formulating problems, formulate hypothesis, identifying variables, formulating operational definition of variables, designing data table, carrying out the experiment, Analyzing the data and drawing conclusions obtained high value as indicated that students can undertake in science process skills indicators.

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