Development of Collaboration Script-Based Worksheets to Improve Collaborative Skills and Learning Outcomes in Junior High Schools Science Learning

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Abstract

Science learning is expected to be capable of various competencies following curriculum demands, including students' collaborative skills. Collaborative skills provide many benefits to students. However, the facts show that the collaborative skills achieved by students in current learning are still low because the learning process is not directed at achieving the desired targets. Thus, this research was conducted to develop a collaboration script-based worksheet to improve junior high school students' collaborative skills and learning outcomes in science learning. This type of research is development research, which is carried out in three stages: the preliminary research phase, the development and prototyping phase, and the assessment phase. The research results show that the collaboration script-based worksheet developed in this research is categorized as valid, practical, and effective. Thus, it can be said that collaboration script-based worksheets can help students learn science collaboratively to improve collaborative skills and student learning outcomes.

Keywords: Collaboration script, Collaborative skills, Learning outcome.

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INTRODUCTION

Science is a subject designed to investigate the relationship between all things related to nature, which are arranged systematically and described not only based on knowledge, concepts, and facts but also accompanied by a process (Lusidawaty et al., 2020). Currently, science learning is expected to be able to meet all the demands of abilities following the implementation of the curriculum that must be present in students in globalization, which is increasingly embedded in every layer of life, one of which is the ability to develop students' collaborative skills which require cooperation and can improve concepts according to with the desired quality (Filjinan, Supeno, & Rusdianto, 2022). However, this is not following what happens in schools where, in meeting the challenges of education in the 21st century, which directs students to demonstrate the ability to think creatively, collaboratively, and communicatively, its presence is still relatively low (Yusuf et al., 2020). Collaborative-based learning requires an active learning process, starting from identifying problems provided by educators to be resolved in a pre-arranged study group, then exploring creative ideas by reading various references containing the issues raised, followed by a collaborative stage where students begin to interact

with each other. Students in group collaboration then carry out elaboration of creative ideas. Finally, an evaluation is carried out to find solutions to all problems that arise appropriately and carefully to increase learning outcomes (Fitriyani, Supeno, & Maryani, 2019). Therefore, developing good collaborative skills can influence student learning outcomes that continue to improve.

The facts show that the collaborative skills that can be created in learning are currently low (Hamdani & Wardani, 2019; Ilmiyatni, Jalmo, & Yolida, 2019; Sari, Prasetyo, & Wibowo, 2017; Sunbanu et al., 2019) because the learning carried out is not directed so it cannot achieve the target as desired. In line with research, Sidi (2020) stated that the assessment results of students' collaboration skills were unsatisfactory because the learning methods used were inappropriate. Based observations at SMP Negeri 2 Panti, it shows that students do not demonstrate good collaboration skills because students are used to studying individually without involving the ability to work together in a group. The low level of collaborative skills can also be identified based on an interview with the science teacher at SMP Negeri 2 Panti, who stated that collaborative skills are needed, not only in selecting material in class and individual learning but also in process skills that require outdoor activities with discussions to achieve common goals.

Collaborative skills, which are still relatively low, influence learning outcomes. For this reason, there is a need to improve learning, one of which is through innovation in learning resources, including innovative worksheet designs. The use of worksheet media that is packaged in a practical way where the contents consist of a summary of theory, instructions, and practice questions that present various problems and then collaborate based on the thoughts of more than one student has the potential to improve collaborative abilities. Aini, Syachruroji, and Hendracipta (2019) stated that to develop a worksheet that integrates various skills, it must meet specific requirements, namely constructive, didactic, and technical so that students can use it. The collaborative skills demonstrated by students require cooperation between students who are required to conduct investigations in groups and can effectively improve learning outcomes (Sari, 2021). Therefore, based on the problems described above, this research aims to develop collaboration script-based worksheets to enhance collaborative skills and learning outcomes of junior high school students in science learning. It is hoped that the results of this research can improve collaborative skills and learning outcomes that can be generated in students through various collaborative activities in education.

RESEARCH METHOD

The type of research used is the development research method. Development research design using the research design type from Nieveen and Flomer (2013) consists of three phases: preliminary research, prototype development and design, and product assessment. The preliminary phase is carried out by analyzing needs and context to obtain various information that is used as material for product design. The development and prototyping phase is carried out by designing worksheet products, learning planning, and learning support systems, followed by the prototype validation process. The assessment phase is carried out to determine the practicality and effectiveness of the product through the implementation of learning

in schools. The learning was implemented in class VII C of SMP Negeri 2 Panti. The research time is the even semester of the 2022/2023 academic year.

The data analysis techniques used include observation, tests, interviews, and questionnaires. After that, the data obtained will be analyzed using the following analysis.

Validity Analysis

The data from the validator questionnaire was then analyzed by examining the scores to assess the validity of the worksheet development product. The formula used to test the validity of development products was adapted from Akbar (2013). Additionally, the validity (*V*) value of a development product was categorized according to the achievement criteria in Table 1.

Table 1. Validity Criteria

Percentage (%)	Criteria	Information
86.00 - 100	Very Valid	Very good to use
71.00 - 85.00	Valid	It can be used with minor revisions
56.00 - 70.00	Fairly Valid	It can be used with significant revisions
41.00 - 55.00	Less Valid	It may not be used
25.00 - 40.00	Invalid	It may not be used

Effectiveness Analysis

Effectiveness analysis aimed to determine the effectiveness of collaboration script-based worksheets in science learning on global warming material, which was measured based on the increase in collaborative skills and student learning outcomes after using the worksheets. Learning outcomes are measured based on knowledge, skills, and scientific attitudes. The following are analytical techniques used to measure the level of product effectiveness.

Collaborative Skills Score

The collaborative skills score (*X*) obtained from student assessments is calculated using the following formula: the percentage of comparison between the achievement of code and the total code.

The average collaborative skills score, calculated by averaging the percentage of scores per task obtained by all students in this research, is determined using the following formula: the comparison between the total percentage score for each student and the number of students.

After obtaining data on the average score of collaborative skills resulting from learning at each student meeting, the average results were categorized based on Table 2 (Source: Widoyoko, 2014).

Table 2. Collaborative Skills Percentage Category

Percentage (%)	Category
$80< X \leq 100$	Very Good
$60< X \leq 80$	Good
$40< X \leq 60$	Enough
$20< X \leq 40$	Less
$0 < X \leq 20$	Very Less

The Normalized Gain Test

Collaborative skills and learning outcomes obtained by students in science learning assisted by collaboration script-based worksheet development products are calculated using the normalized gain (N-gain) test and then categorized based on effectiveness criteria interpreted from the N-gain test value. There are two types of N-gain test in this research: tests to measure the increase in collaborative skills and the increase in learning outcomes using students' pretest and posttest scores.

The increase in collaborative skills among students was analyzed using the N-gain (g) formula, which is calculated as follows: the difference between the collaborative skills score in the last lesson and the collaborative skills score in the first lesson is compared with the difference between the maximum score and the collaborative skills score in the first lesson.

The normalized gain (g) test to measure improvement in learning outcomes was analyzed using the N-gain formula. The formula is calculated as the difference between the posttest score and the pretest score, compared with the difference between the maximum score and the pretest score.

The average N-gain value that has been obtained is then categorized based on the effectiveness criteria of the N-gain test value measuring collaborative skills and student learning outcomes, as shown in Table 3 (Source: Hake, 1998).

Table 3. N-gain Criteria

The Normalized Gain Score	Criteria
$g < 0.30$	Low
$0.70 > g \geq 0.30$	Enough
$g \geq 0.70$	High

Student Response Questionnaire

Data acquisition based on student response questionnaires after learning using worksheets is analyzed using the formula (R): the percentage of comparison between the score acquisition and the maximum score. The analysis results of student responses are categorized based on the criteria in Table 4 (Source: Auliya & Lazim, 2020).

Table 4. Student Response Questionnaire Score Category

Score Interval (%)	Category
$81.25 < R \leq 100$	Very Good
$62.5 < R \leq 81.24$	Good
$43.75 < R \leq 62.4$	Not Good
$25 < R \leq 43.75$	Bad

RESEARCH RESULTS

This research collected data using observation and tests to measure improvements in collaborative skills and learning outcomes in knowledge, skills, and attitudes. Measuring the increase in learning outcomes in the realm of expertise, using test questions in the form of a pretest and posttest of 10 items to determine the increase in students' mastery of concepts at the first and last meeting, then interviews were conducted which were used to find out the condition of the school when learning

took place, especially the implementation of collaborative activities. The data produced in this research includes analysis of worksheet validation, the effectiveness of collaboration script-based worksheets, and learning outcomes.

Worksheet Validation Analysis

Collaboration script-based worksheet products are validated by three expert validators based on predetermined aspects. The validation results are then analyzed through the total average score for each learning aspect and then categorized based on a product's average validity interval. The results of the collaboration script-based worksheet can be seen in Table 5.

Table 5. Results for Collaboration Script-Based Worksheet Validation

Validation Aspects	Internal Score			Percentage (%)	Category
	Validator 1	Validator 2	Validator 3		
Contents	1,00	0,90	0,95	95	Very Valid
Language	1,00	0,90	1,00	97	Very Valid
Appearance	1,00	0,90	0,95	95	Very Valid
CLT	1,00	0,83	0,92	92	Very Valid
Average	1,00	0,88	0,95	95	Very Valid

Note: CLT= Collaborative Learning Tendency.

Table 5 shows the results of the validation of the development product in the form of a collaboration script-based worksheet, which is said to be very valid, which can be seen based on the average score having a percentage value of 95% where the product is suitable for use (V>86). The assessment aspects used include the appropriateness of content, language, presentation, and collaborative learning tendencies, with an overall average categorized as valid intervals.

Effectiveness of Collaborative Script-Based Worksheets

Collaborative skills are assessed using an observation sheet that contains indicators and aspects of collaborative skills during the learning process using a collaboration script-based worksheet. The results of the analysis of the average effectiveness of the worksheet can be seen in Table 6.

Table 6. Collaborative Skills Percentage Analysis Results for Each Lesson

Aspects		Lesson					Score
		1	2	3	4	5	
Working Collaboratively	A	0.38	0.56	0.69	0.78	0.91	66.56
	B	0.44	0.53	0.66	0.78	0.94	
Appreciate	C	0.41	0.53	0.69	0.78	0.88	65
Compromise	D	0.41	0.59	0.75	0.78	0.94	68.75
Share and Contribute	E	0.34	0.53	0.66	0.84	0.97	
	F	0.41	0.63	0.72	0.84	1	69.38
	G	0.38	0.59	0.75	0.78	0.97	
Average		39.29	56.7	70.09	79.91	94.2	67.42
Category		NE	E	G	G	VG	G

Note: NE= Not Enough; E= Enough; G= Good; VG= Very Good.

Table 6 shows the result of an analysis of collaborative skills for each lesson, which was assessed based on four aspects: working collaboratively, respecting, compromising, sharing, and contributing. Each element measured has various indicators shown, including A, namely working productively by using time efficiently to solve problems, B, dividing tasks according to the abilities of group members so that they are completed on time. One indicator shown by C is showing respect and mutual respect for differences of opinion within the group. In compromising, one indicator is led by D, namely compromising among group members and being able to reach joint decisions flexibly according to agreement. The fourth aspect, namely sharing and contributing, has three indicators, including E, namely collective responsibility in completing existing work, F, namely exchanging opinions in conducting discussions, debates and making decisions, G, namely contributing by doing the best and always following what is agreed assigned.

The effectiveness value of the collaboration script-based worksheet is obtained from the collaborative skills at each lesson, which increases as measured using the N-gain formula. The N-gain analysis data for improving collaborative skills at each meeting can be seen in Figure 1.

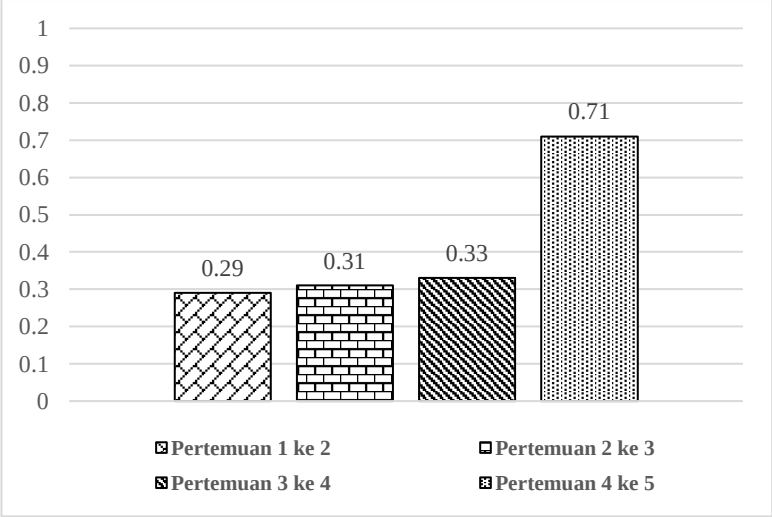

Figure 1. The collaborative skills improvement analysis results

Figure 1, regarding the analysis of collaborative skills, shows that collaborative skills increased at each lesson from the first to the fifth lesson with an N-gain difference of 0.42. Therefore, science learning using collaboration script-based worksheets is considered effective in improving collaborative skills in its implementation.

Learning Outcomes

Learning outcomes are a definition of a pattern carried out by students who were previously unable to do something that is used as a form of desired competency (Andriani & Rasto, 2019). Learning outcomes in this study's knowledge or cognitive domain were measured using assessment instruments in the form of pretest and posttest questions. In contrast, in the skills and attitudes domain, they were measured using observation sheets according to the aspects and indicators of

the learning outcomes to be achieved. In the knowledge domain, test results were obtained in the form of pretest and posttest questions. The average score obtained by students can be seen in Figure 2.

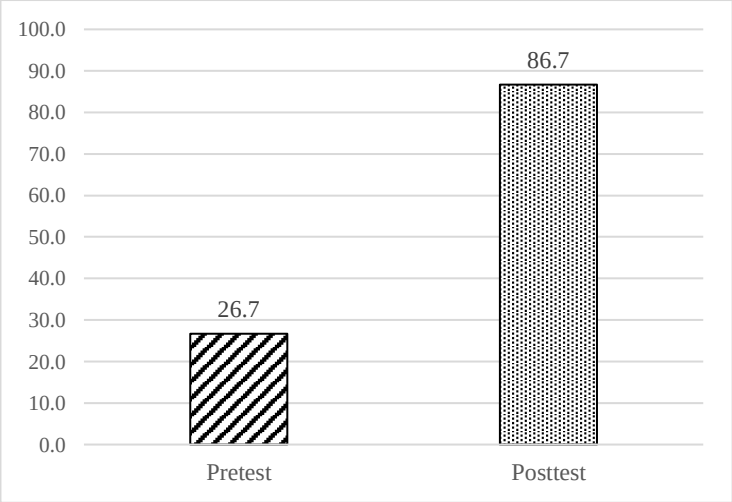

Figure 2. Average of pretest and posttest

Figure 2 shows that the effectiveness of learning outcomes in the knowledge domain has increased, as evidenced by the increase in participants' average pretest and posttest scores before and after using collaboration script-based worksheets, obtaining a score of 60. The results of the N-gain analysis increased student learning outcomes in The knowledge domain using collaboration script-based worksheets, which can be seen in Table 7.

Table 7. N-gain analysis of learning outcomes in the domain of knowledge

Components	Pretest	Posttest
The number of students	32	32
Minimum Score	8	66
Maximum Score	43	100
N-gain	0.82	
Category	High	

Table 7 shows that the N-gain value obtained by students is 0.82 and is included in the high category. This data means that knowledge as an indicator of learning outcomes has increased so that collaboration script-based worksheets are considered effective in improving students' understanding.

The skill or psychomotor domain as one aspect of improving learning outcomes by students increased from the 1st lesson to the 5th lesson. The results of the analysis of the average increase in students' learning outcomes skills can be seen in Table 8.

Table 8 shows that the average value of learning outcome skills obtained based on seven aspects: planning, preparation, questioning, observing, gathering information, concluding, assigning, and communicating, increased at each meeting. The collaborative skills of the first lesson were declared poor until the fifth lesson was declared very good, with an average obtained in the excellent category.

Table 8. Increased Skills Domain of Learning Outcomes for Each Lesson

Aspects	Lesson					Score
	1	2	3	4	5	
Planning and Preparation	0.47	0.59	0.78	0.84	0.94	72.50
Ask	0.44	0.56	0.75	0.84	0.97	71.25
Observe	0.47	0.63	0.72	0.88	0.94	72.50
Gather Information	0.47	0.59	0.69	0.78	0.94	69.38
Conclude	0.47	0.63	0.75	0.81	1	73.13
Assignment	0.53	0.59	0.69	0.81	0.94	71.25
Communicate	0.47	0.63	0.72	0.84	0.94	71.88
Average	47.32	60.3	72.77	83.04	95.09	71.70
Category	NE	E	G	VG	VG	G

Note: NE= Not Enough; E= Enough; G= Good; VG= Very Good.

Furthermore, the effectiveness value of the collaboration script-based worksheet was obtained from observing the skills at each lesson, where an increase was measured using the N-gain formula. The N-gain analysis of learning outcomes in the skills domain for each meeting can be seen in Figure 3.

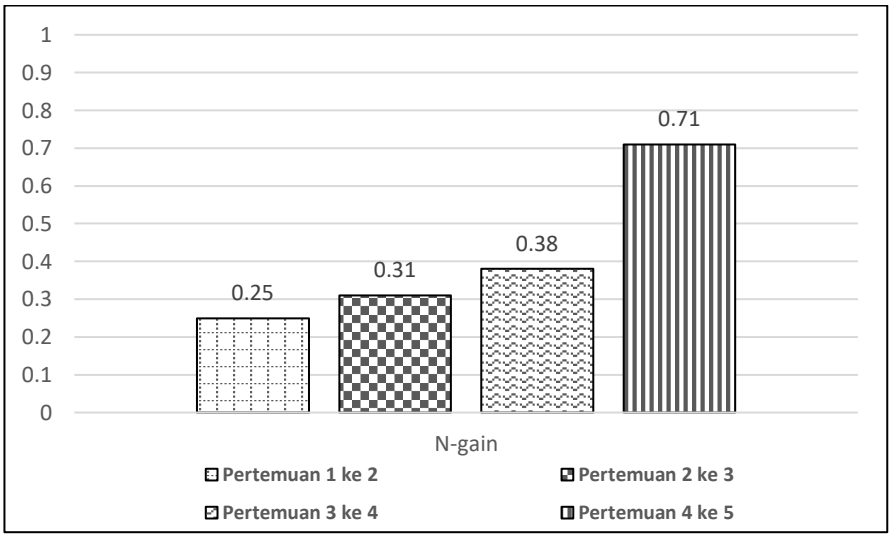

Figure 3. N-gain analysis of improving learning outcomes of skills domains

Figure 3 shows that the learning outcomes increased at each meeting, namely in the skills domain, from meeting 1 to meeting 5, with a value of 0.49. Thus, learning using collaboration script-based worksheet media is considered effective in improving students' learning outcomes skills by measuring learning outcomes in the increase in grades for each lesson.

Apart from knowledge and skills, other aspects of improving learning outcomes in the form of students' scientific or affective attitudes also tend to increase from the first to the fifth. The analysis results of the percentage increase in students' scientific attitudes during learning at each lesson can be seen in Table 9.

Table 9 shows that the average analysis of learning outcomes in the domain of skills obtained is based on eight aspects, including an attitude of curiosity, an attitude of respect for data or facts, an attitude of critical thinking, an attitude of discovery and creativity, an attitude of open review, an attitude of cooperation, an

attitude of perseverance, and the sensitive attitude towards the surrounding environment increased from the first meeting which was still categorized as poor to the fifth meeting which resulted in a score in the perfect category.

Table 9. Results of Learning Outcomes Analysis in the Scientific Attitudes Domain

Aspects	Lesson					Score
	1	2	3	4	5	
a. Curious attitude	0.44	0.66	0.75	0.81	0.91	71.25
b. Respectful towards data or facts	0.50	0.50	0.72	0.78	0.91	68.75
c. Critical attitude	0.47	0.60	0.75	0.88	0.97	72.50
d. An attitude of discovery and creativity	0.50	0.66	0.72	0.81	0.94	72.50
e. Open attitude	0.53	0.59	0.75	0.84	0.97	73.75
f. Collaborative attitude	0.47	0.66	0.75	0.81	1	73.75
g. Attitude of perseverance	0.53	0.63	0.72	0.88	0.97	74.38
h. Sensitive attitude toward the surrounding environment	0.53	0.66	0.72	0.81	0.94	73.13
Average	49.60	61.72	73.44	82.81	94.92	72.50
Category	NE	E	G	VG	VG	G

Note: NE= Not Enough; E= Enough; G= Good; VG= Very Good.

Data on improvements for each aspect of scientific attitudes in measuring learning outcomes can be seen in Figure 4.

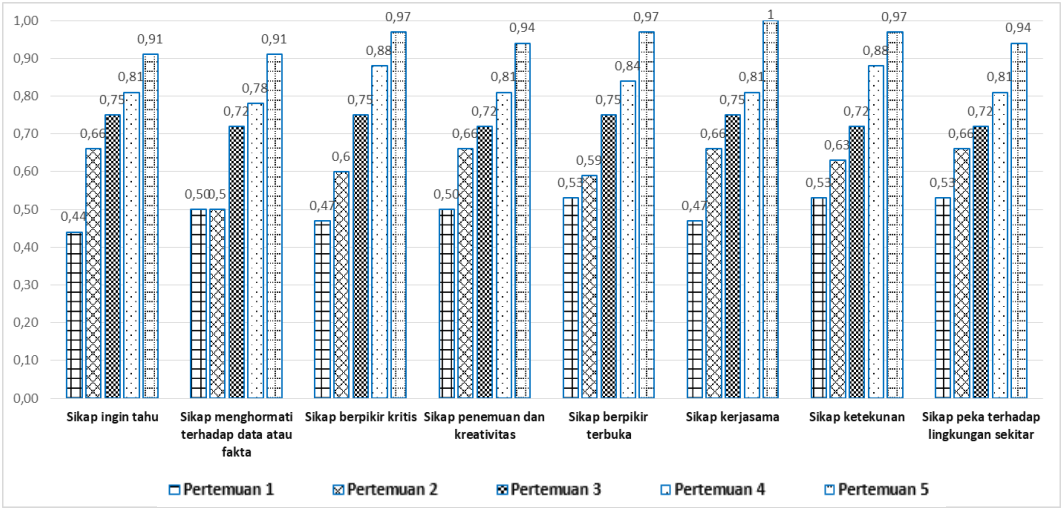

Figure 4. Learning results of scientific attitude domain at each lesson

Based on Figure 4, it is known that the eight aspects of learning outcomes in the realm of scientific attitudes in each aspect change according to the meeting. The effectiveness value of the collaboration script-based worksheet was obtained from observing scientific perspectives as another aspect of learning outcomes at each meeting, which experienced an increase as measured using the N-gain formula. The N-gain analysis of learning outcomes in the realm of scientific attitudes at each lesson can be seen in Figure 5.

Figure 5 shows that at each lesson, there was an increase in scientific attitudes in learning outcomes from the first to the fifth, namely 0.46. Thus, learning using

collaboration script-based worksheet media is considered effective in improving scientific attitudes by measuring learning outcomes in the increase in grades for each meeting.

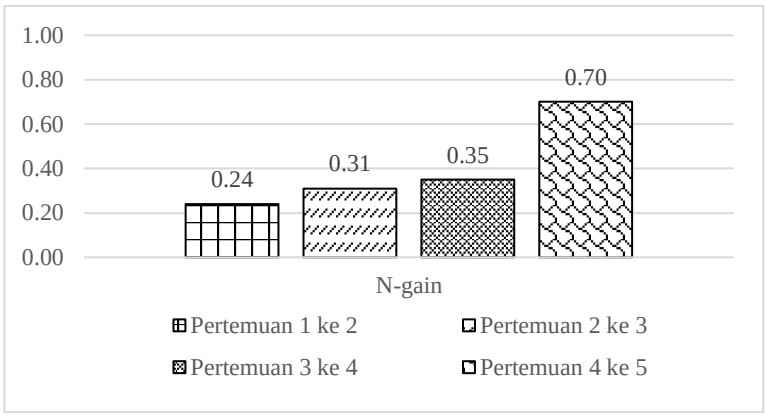

Figure 5. N-gain analysis of scientific attitude increasing

The N-gain value shows the increased scientific attitude towards learning outcomes, which has increased the difference between the initial and final meetings in the adjusted time interval.

DISCUSSION

Data analysis of the validity of collaboration script-based worksheet development products on global marketing materials obtained the results of the average validation scores of experts, which stated that collaboration script-based worksheets follow the needs in every aspect, including content, language, presentation, and tendency to learn collaboratively, so it could be said to be feasible and valid with the need for slight improvements. The validity of the developed product is based on van den Akker et al. (2012), who states that the media or creation is valid by looking at the relationship between the product and considering the objectives of product development. Product validity criteria include construct validity and content validity, where construct validity contains the relationship between components in product development. Meanwhile, content validity consists of the features that underlie the creation of the product whose connections will be analyzed. According to Ginantara and Aguss (2022), a development product is said to be valid if it obtains validation results that are in the 60%-100% interval. Collaboration script-based worksheet revisions are carried out at the validation stage of product refinement. The revision process is based on criticism and suggestions by the validator regarding the contents of the collaboration script-based worksheet before it is deemed suitable for testing with students.

The effectiveness of collaboration script-based worksheets to improve collaborative skills in each aspect shows that the worksheets are considered adequate. Effective teaching materials can create practical and interactive learning, allowing students to move to find information, solve problems, and convey ideas (Adikalan, Supeno, & Wicaksono, 2022). One of the aspects measured, namely the aspect of sharing and contributing, has the highest score of 69.38% and is included in the excellent category because students tend to divide tasks into groups so that

all group members can be responsible. Research by Widayanti et al. (2022) states that the contributing aspect is considered good when students can constructively accept their assignments or instructions.

The element of collaboration with the second highest score is compromised, namely 68.75%, and is included in the excellent category because, at this stage, students can compromise with fellow group members and flexibly accept joint decisions as a solution to solving problems in the worksheet. Fitriyani, Jalmo, and Yolida (2019) said that compromise can be considered good if students can flexibly solve problems through teamwork by exchanging ideas through investigation and information discovery. The collaboration aspect with the third highest percentage is working collaboratively at 66.56%, which is included in the excellent category because students are able to work productively by using time as efficiently as possible in the problem-solving discussion process, besides that, students are pretty punctual in working on worksheet-based collaboration script by dividing tasks according to the abilities of group members. Pratiwi and Rachmadiarti (2022) stated that working collaboratively emphasizes students' freedom to share lessons by comparing conclusions and each work procedure. The aspect of collaboration with the lowest percentage lies in the respect aspect, namely 66%. It is still categorized as good because students do not respect the opinions of their group colleagues. Putri and Susantini (2021) stated that respect is considered good when students can appreciate differences of view in the group and the contributions made.

The effectiveness of the development product in the form of a collaboration script-based worksheet is also reviewed from the students' responses after learning using the worksheet through questionnaire data. The analysis of students' responses to learning products shows that based on questionnaire analysis, they obtained an average score of 91% and are included in the outstanding category. Thus, it can be interpreted that collaboration script-based worksheets as a development product carried out during learning have received perfect responses from students, and every aspect of education is considered capable of obtaining student responses with ideal criteria.

Developing collaboration script-based worksheets can improve collaborative skills and student learning outcomes. Nurjanah, Rudibyani, and Sofya (2020) stated that collaborative skills involve member participation in every team collaboration to build relationships with other people. Collaborative skills continue to improve as the number of meetings increases. Utilizing all the activities in collaboration script-based worksheets, students demonstrate all aspects of enhancing collaborative skills, including working collaboratively, respecting, compromising, sharing, and contributing. Students can coordinate various opinions in their group through problem-solving without burdening just one party. All group members, through activities, exchange ideas with a high sense of respect between group friends and compromise to complete the task on time. Discussion activities take place to improve good problem-solving; there are peer tutoring activities between friends with different views and opinions in responding to the problems presented.

Increased collaborative skills affect improving student learning outcomes. Initially, students only involved ideas individually so that there was no interference from other people to solve problems better and produce acceptable decisions to all parties. Thus, direct discovery activities through process skills during science learning can make students remember the results of the learning discussions that

have been carried out longer. Increased learning outcomes cover three domains, including knowledge, skills, and attitudes, so that knowledge and learning outcome skills such as planning and preparation skills, asking questions, observing, gathering information, concluding, assigning, and communicating continue to improve at each meeting. Apart from that, students are considered capable of developing scientific attitude skills, including an attitude of curiosity, respect for data or facts, critical thinking, an attitude of discovery and creativity, an attitude of open review, an attitude of cooperation, an attitude of perseverance, and an attitude of sensitivity to the surrounding environment.

CONCLUSION

The research results show that the collaboration script-based worksheet developed in this research is included in the valid, practical, and effective categories. The collaboration script-based worksheet obtained an average validity percentage of 95%. Worksheets can be applied in learning to improve collaboration skills and student learning outcomes. In its implementation, collaboration script-based worksheets can help students develop their collaboration skills. Students carry out learning activities, both physically and mentally, following the instructions in the worksheet. Students work collaboratively in study groups to construct scientific knowledge. Thus, collaboration script-based worksheet media can improve collaborative skills and student learning outcomes. For this reason, learning using collaboration script-based worksheets is practical and suitable as teaching material on global warming material.

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