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Collaborative Problem Solving (CPS) Based Collaboration Skills Rubric in Natural Science Learning

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Abstract. This study aims to develop and analyze the feasibility of collaboration skills based on the Collaborative Problem Solving (CPS) rubric in junior high school science learning which is feasible from the aspects of validity and practicality. The research method used is the method of research and development of the Borg and Gall model which is limited to only 7 stages. Data collection techniques and tools are adapted to the research stage. The results of the validation of the research content using the Lawshe formula obtained CVI (Content Validity Instrument) = 0.99. Practicality tests through a questionnaire response to educators in a limited manner obtained positive statements of 92.55% and widely obtained positive statements of 97.35%. The conclusion of this research is that collaborative skills rubric is feasible to be used to measure collaboration skills in science learning in junior high schools. Keywords: collaboration skills, CPS, natural science learning.

1. Introduction

The development of science and technology in the 21st century requires the Indonesian nation to prepare human resources capable of showing excellence for the progress of the nation. The role of education is getting heavier because the success of education is one of the indicators of the nation's progress. Students in the 21st century are not sufficient to only master knowledge or metacognitive but must be able to think critically, creatively, communicate, and collaborate[1](Greeenstein, L 2012). Research result (Hampson,dkk 2011)[2]concluded that among the factors associated with improving the skills of the 21st-century learners are teachers. High-quality teachers are those who have a strong influence on student achievement. Teachers must anticipate the development of the 21st century through learning so that students have 21st-century skills.

Some strengthening has been made by the Indonesian government in developing 21st century skills. Through the implementation of the current 2013 curriculum which emphasizes 4C skills (critical thinking, collaboration, creativity, and communication) in learning, it is hoped that teachers can develop 21st century skills.These 4C skills can help learners and adapt students to changes over time[3](Saenab, dkk 2019).

Collaboration skills are one of the skills needed in the 21st century. Collaboration skills are a learning process to plan and work together, consider different views or perspectives, how to participate in discussions, for example, brainstorming, listening, and supporting others [1] . Many problems faced in the modern world require a team that has special abilities as team members[4](Arthur,dkk, 2018).Collaboration skills emphasize teamwork in achieving goals, so it is very important to be developed in the current era of globalization.

The era of globalization influences the social life of students. Social interaction is mostly done in cyberspace, making it difficult to interact with other people in real life. This will have an impact on the world of work when they are asked to competently interact or develop working relationships with others. Collaboration skills are very important to be developed in the learning process so that students can work together in different groups as a provision to face the world of work [5] (Muiz,dkk, 2016)[6]Hidayati, N,2019). Collaboration is also an important educational outcome and one of the key skills of the 21st century[7](Pelegrini, 2014). Thus, students who have collaboration skills will easily cooperate with others and enter the world of work later, because they are easy to adjust and can respect differences in views with others.

Collaboration skills have not become the attention of educators in preparing students to face the globalization era, because the use of learning models has not supported the development of these skills. Learning is still centered on educators, so students do not have the experience of how to work well with others [8](Boholano,2017).On the other hand, the results of a preliminary study (2020) in science learning at SMP Rasau Jaya, Kubu Raya Regency, found that educators in learning have used a learning model that is centered on students as an effort to improve the quality of learning, for example, inquiry, problem solving, projects, and cooperation, but assessment The process in group discussion activities to solve problems and make practice reports has not been evaluated by educators [9](Redhana, I,2015).

Assessment of student learning outcomes is an integral part of the learning process. Through the assessment, educators will get the results of the learning process carried out, so that they can reveal the achievement of student competencies which include aspects of knowledge, attitudes, and skills [10](Redhana,W,2010).The lack of understanding in developing the assessment process assessment becomes an obstacle in developing the 21st-century skills assessment so that educators do not have a clear and comprehensive picture of the 21st-century skills students have so far. The teacher's usual assessment is only on the final results of group work, without objectively assessing the collaboration skills of each student.

Collaborative skills possessed by students need to be detected by the teacher from the start, given the importance of pregnancy in students. Collaborative skills assessment tools can be implemented objectively if the learning carried out by the teacher is based on Student-Centered-Learning (SCL). Students are actively involved in various learning activities, so that various 21st-century skills can be trained, including collaborative skills. Students' collaborative skills can be developed, so the teacher must package the learning by selecting the appropriate learning model so that collaborative skills can be trained in learning. One of the learning models that can facilitate 21st-century skills is being developed, namely the collaborative problem solving (CPS) learning model. This learning model is suggested in the 2013 curriculum.

The CPS learning model is a combination of collaborative learning and problem-solving learning. Collaborative learning is learning that involves students in group collaboration to solve problems/tasks or make certain products [11] (Laal,m,2012).Collaboration between students in groups can create productive collaboration and students become responsible for their duties. Collaboration is a style of interaction in which two or more work together professionally to achieve goals[12](Murawsky, 2010).

CPS is learning that prioritizes the process of collaborating students in groups to solve problems, so that students can build their knowledge based on their initial knowledge[13](Nahdi, D.S, 2017).CPS can also be used as an alternative model that can be developed to improve students' collaborative problem-solving skills [14](Putra, 2015).Problem-solving learning has an impact on student learning activities

because students are allowed to carry out discussion activities so that their ability to work together becomes even better [15](Lu,H.K &Lin, P.C.,2017)

Based on the opinions of the experts above, it can be concluded that the CPS learning model is a learning stage that emphasizes the collaboration process of two or more people who have the same goal to agree in trying to solve a problem. The agreement is based on the collaborative process of each student in building his knowledge with a variety of knowledge and skills. In CPS learning, students are presented with a problem that must be solved individually and in groups.

Taking into account the above facts, it is very urgent to develop a collaborative problem solving (CPS) -based collaboration skills rubric in science learning at SMP, Kubu Raya Regency. The purpose of this research is to produce a product in the form of a CPS-based collaboration skills assessment tool that is feasible in terms of validity and practicality so that it provides benefits for educators and students. The resulting product can be used by educators to objectively determine the collaboration skills of students so that the results can be a reference for improvement in the learning process. Likewise, students, the results of collaborative skills assessment by educators can be used as a reference in self-improvement or improvement.

2. Research Methods

This type of research is research development or R & D (Research and Development). Research and development is a series of processes or procedures to develop new products or improving existing products so that they can be accounted for [16] (Tegeh,dkk,2014). The development in this study is a collaborative problem solving-based collaborative skills assessment tool in science learning in junior high schools withThe research steps refer to the development procedure according to Borg and Gall [17](Borg&Gall,1989), namely: 1) Research and data collection; 2) Planning; 3) Initial product development; 4) Initial field trials; 5) Revised trial results; 6) Field trials; 7) operational product revision, 8) operational field test, 9) final product revision and 10) dissemination. However, this research it was only conducted up to stage 7 (seven).

The research subject in development is a collaborative based assessment tool Collaborative Problem Solving with the trial subjects were junior high school science educators in Kubu Raya Regency. The initial product development stage is carried out the validation of the product being developed. Validation is carried out is the content validity that is estimated by testing the appropriateness or relevance of the test content through a competent panel or expert judgment (expert judgment). Content validity ensures that the measurement includes an adequate and representative set of items that reveal the concept. Furthermore, the initial field trials carried out the practicality test of the product development in a limited group of junior high school science educators in Kubu Raya as many as 10 people and a broad group of 15 people.

The techniques and instruments used in research adjust to the stage of development activities carried out. In detail, the techniques and instruments are as follows:

Table 1. Research Techniques and Instruments

No.	Activity step	Technique	Instrument
1	Research and data collection	Interview	interview guidelines
		Observation	Ceklist, anecdotal record
		Literature review	-
		Questionnaire	Questionnaire sheet (google form)
2	Planning	Discussion	Discussion minutes
3	Early product development	Discussion	Planning results
4	Initial field trials	Measurement	Questionnaire sheet for the validity of development products (experts)
		Measurement	Questionnaire about product practicality for teachers (limited limited trial)
5	Revised trial results	Research team	Results of initial field trials

No.	Activity step	Technique	Instrument
		discussion	
6	Field trials	Measurement	Questionnaire on product practicality for educators (extensive trial)
7	Operational product revision	Discussion	Field trial results

The research procedure for developing collaborative problem solving-based skills assessment tools can be described in 'Figure 1' below.
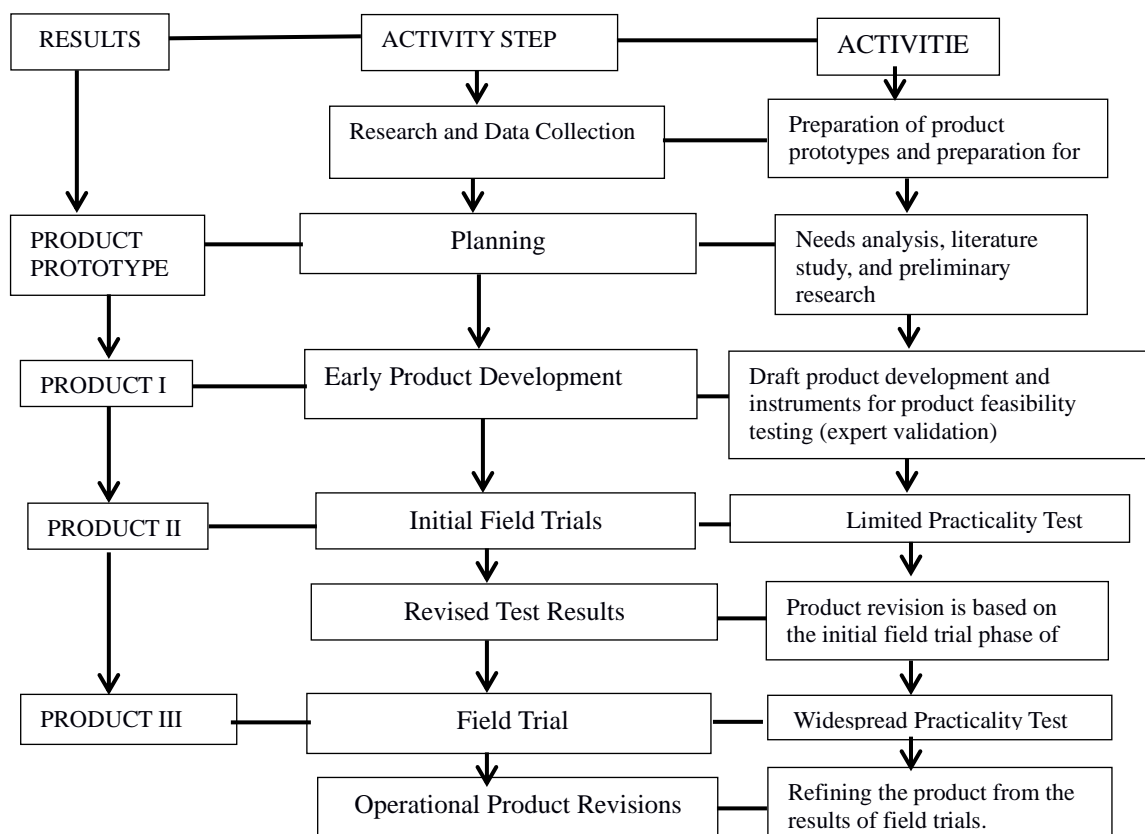
Figure 1. Development Research Procedure

Data analysis carried out in the development of collaborative problem solving-based assessment tool products in detail can be seen in 'Table 2'.

Table 2. Analysis of Research Data

No.	Formulation of the problem	Data analysis
1	Determine the validity of the content of the CPS-based collaborative skills assessment rubric in science learning	1. Questionnaires to validate collaboration skills assessment tools were distributed to experts material, assessment construction, and language. 2. Calculating the content validity of the Lawshe concept with the formula: [18]$CVR = \frac{2n_e}{n}$ 3. The CVR calculation results are compared with the CVR minimum standard table based on SME Table 1. CVR Minimum Standards

No.	Formulation of the problem	Data analysis
	in junior high schools	Based on SME

Number of SMEs	Minimum CVR Value
5	0.99
6	0.99
7	0.99
8	0.75
9	0.78
10	0.62

No.	Formulation of the problem	Data analysis
2	Determine the practicality of the CPS-based collaboration skills assessment rubric in science learning in junior high schools	1. Validating the response questionnaire instrument to the expert 2. Carry out practical tests on educators. 3. Analyze the response questionnaire data $$\frac{jumlah\ skor}{Banyaknya\ Responden}$$ 4. Determine the average percentage score. 5. Comparing the results of the percentage average score with the validity category of the assessment instrument[19]

Average Score	Classification
$3.25 \leq M \leq 4$	Very Valid
$2.5 \leq M \leq 3.25$	Valid
$1.75 \leq M \leq 2.5$	Enough Valid
$1.0 \leq M \leq 1.75$	Not Valid

3. Results and discussions

The CPS-based collaboration skills rubric which was developed refers to the Rubric For Assessing Students' Collaborative Skills by Valente (2016)[20], consisting of 7 criteria, namely: Focus on tasks, Mutual help, Responsibility, and reliability, Team Leader's performance, Team Reporter's performance, Organizer's performance. , and Lead Researcher's performance. Product development is carried out through preliminary study activities (research and data collection stages). The needs of educators and students as well as relevant theories become a reference in this development. This stage is planning (planning stage) by making a product prototype collaboration skills rubric with 12 criteria (contribution, time management, quality of work, problem-solving, synthesis, attitudes, and behavior, focus on work, preparation, pride, monitoring group effectiveness, working with others, and inquiry techniques), skills rubric validation instrument collaboration, instrument validation of practicality test responses, and schedule of content validation and practicality testing. Furthermore, the development stage is validated with 10 (ten) experts. This expert is provided with instruments for validating the content of the rubric and the theory of collaboration skills and CPS. The expert provides written input on the distributed rubricate).

The product prototype developed was tested for validity to determine the accuracy of the CPS-based collaboration skills rubric in science learning to measure collaboration skills (development stage). The validity is the level of accuracy and accuracy of a measuring instrument/test in carrying out its function as a measuring tool/test (Rogier, 2014)[21] (Hairida, 2017[22]).At this stage, 10 (ten) instrument/assessment experts perform the content and construct validity. This expert is given a validation instrument for the content of the rubric, and the theory of collaboration skills and the CPS

then provide written input on aspects of content suitability, construction, and readability of the rubric that are distributed.

Table 3. Validator's Inputs to Rubrics

Validator	Comment	Before the Revision	After the Revision
1,4,5, and 7	The name "validation sheet ..." is not specific, you should add the word "rubric"	Validation Sheet for CPS-Based Collaboration Skills Assessment in Natural Science Learning in Junior High School Validation Sheet	Validation Sheet for Collaborative Skills Rubric Based on Collaborative Problem Solving in Science Learning in Junior High Schools
2, 3, 5, 6,7 and 8	Correction of the statements of criteria 1, 2,… 12 with add the frequency of its quality.	Example: I very often provide ideas and benefits when participating in group and class discussions) and can lead discussions. I often provide ideas and benefits when I participate in group and class discussions and lead discussions I provide ideas and benefits when participating in group and class discussions and leading discussions very rarely.	I very often provide ideas and benefits when participating in group and class discussions (more than 2 times) and being able to lead discussions (more than 2 times) I often provide ideas and benefits when I participate in group and class discussions and lead discussions (only 2 times) I provide ideas and benefits when participating in group and class discussions and leading discussions very rarely (only once)
1, 3, 7, 8, 9 and 10	Adjust the choice of words with the thinking level of junior high school students, for example the word organize	I organized the teacher's initial knowledge and explanations in the classroom to complete the assignment I was given without help from others.	I relate various self-found information and the teacher's explanations in the classroom to complete the assignment I was given without the help of others.
4	Correction of the word "work" to "task", according to the words that are often used in School	I immediately finished the job with high quality, so I didn't need to be checked by the group.	I completed the assignment given to me by the provisions and even exceeded the provisions that had been given by the educator, so it did not need to be checked/completed by the group..
2, 3, 4, 6, 9, 10	Correction of the sentence "complete", the measurement must be clear.	I use full resources and information notes to complete the group discussion.	I use 4 reading sources in completing group discussions, namely: 1. package book 2. reading material from the teacher 3. information from the teacher 4. additional reading

Vali-dator	Comment	Before the Revision	After the Revision
			material that I find myself
6, 8	The statement is less clear because this rubric is for junior high school students, the maximum quality should be operationalized.	I immediately finished my work with the maximum quality (best)	I completed the assignment given to me following the provisions or exceeded the provisions that the teacher had given, so it did not need to be checked/completed by the group.
4, 7, 10	The statement is less clear in the sentence "facilitating group work". Should be operated according to the thinking level of junior high school students	I listen very well and help people in group discussions and facilitate group work	I very often (more than 2 times) listen to and help other people to solve problems and provide alternative solutions to problems in group discussions

The validator's input above is used as a reference in improving the collaboration skills rubric, the results are in 'Table 4'.

Table 4. CPS-Based Collaborative Skills Assessment Rubric Results of Content Validation

Aspect of Collaborative Skills	Statement / Score			
	4	3	2	1
Contributions	I very often provide ideas and benefits when participating in group and class discussions (more than 2 times) and being able to lead discussions (more than 2 times)	I often provide ideas and benefits when I participate in group and class discussions and lead discussions (only 2 times)	I provide ideas and benefits when participating in group and class discussions and leading discussions very rarely (only once),	I do not give ideas and do not participate in group and class discussions.
Time-Management	I am on time or before the deadline for completing the task given to me, so that the group can finish on time.	I am sometimes a little late in completing the assignment given to me (3 - 5 minutes), but it hasn't caused the group to need to increase the time for the task.	I was often late in completing the assignment I was given (more than 5 minutes), so the group was late in collecting the assignment.	I did not complete the assignment that was given to me, so the group was late in completing the assignment ..
Quality of Work	I completed the assignment given to me in accordance with the provisions and even exceeded the provisions that the teacher had given,	I completed the assignment given to me in accordance with the provisions given by the teacher, so it	I finished the assignment that was given to me, sometimes (only 2 tasks) there were things that didn't match the	I often complete assignments (more than 2 tasks) not in accordance with the provisions, so every task I do

Aspect of Collaborative Skills	Statement / Score			
	4	3	2	1
	so it did not need to be checked / completed by the group.	didn't need to be checked / completed again by the group.	requirements so I was reminded by the group.	needs to be checked carefully and completed again by group members.
Problem-Solving	I very often (more than 2 times) seek and offer ideas of my own to answer group problems.	I often (only 2 times) looked for answers to problems, but these answers were the result of developing other people's ideas/opinions.	I rarely (only once) seek answers to problems, directly using answers from my group friends.	I do not seek and offer answers to problems, relying directly on answers from friends
Synthesis	I relate various self-found information and the teacher's explanations in class to complete the assignment I was given without the help of others.	I relate the information I found myself and the teacher's explanation in class to complete the assignment I was given, but sometimes (only once) I need someone else's help to complete the assignment.	I relate the information found by myself and the teacher's explanation in class to complete the assignment given to me, but often (only 2 times) need help from others to solve problems.	I don't process existing information to solve problems because I very often (more than 2 times) rely on other people to solve problems
Attitude	I never give bad comments on other people's assignments or work in public, but I give advice directly to the person concerned and always think positively about tasks done by friends.	I have (only once) gave bad comments about other people's assignments or work in public, and have had negative thoughts (only once) about assignments done by friends.	I often (only 2 times) gave bad comments about other people's assignments or work in public and often thought negatively (only 2 times) about tasks done by friends.	I very often (more than 2 times) gave bad comments about other people's assignments or work in public and very often (more than 2 times) thought negatively about tasks done by friends.
Focus on the task	I am very focused on completing assignments given by the teacher, both independently and in groups without waiting for orders.	I focus on completing assignments given by the teacher independently or in groups, after an order is given.	I sometimes don't focus (only once) on the task that needs to be completed, so my group mates remind me to do the task.	I often do not focus (more than or equal to 2 times) on the task that must be completed, so I need my group mates to finish it.

Aspect of Collaborative Skills	Statement / Score			
	4	3	2	1
Preparedness	I carry my assigned equipment complete and ready to work in group activities.	I brought the equipment that was assigned to me but was incomplete (lacking 1), so the group rearranged the activities to be carried out.	I brought equipment but it was very incomplete (less than 2) so that group activities were disrupted..	I did not bring the necessary equipment in the group, so group activities could not be carried out.
Pride	I give all the best of myself in completing the task to be the best and I can be a mainstay in the group..	I complete the assignment according to the provisions given by the teacher without having to be the best and become the mainstay of the group.	I sometimes complete assignments without being by the provisions (only once), so my group friends are reminded.	I often complete assignments without meeting the requirements (2 times or more than 2 times) because I rely on a group of friends
Monitor group effectiveness	I very often (more than 2 times) pay attention to group friends who work and give suggestions to the group to work well.	I often (only 2 times) pay attention to group friends working and advise the group.	I rarely (only once) paid attention to group friends working and advised the group.	I don't pay attention to friends who work in groups and don't give advice to groups.
Working with Others	I very often (more than 2 times) listen to and help other people to solve problems and provide alternative solutions to problems in group discussions.	I often (only 2 times) listen to and help other people to solve their problems in group discussions	I rarely (only once) listened to and helped others to solve problems in group discussions.	I just listen without helping others solve the problem in group discussions
Research Techniques	I use 4 reading sources. Source: 1. the package book 2. reading material from the teacher 3. information from the teacher 4. additional reading material that I find myself	I use 3 reading sources. Source: (only uses 3 of 4 sources)	I use 2 reading sources. Source: (only uses 2 of 4 sources)	I use 1 reading source. Source: (only uses 1 of 4 sources)

The revised rubric was then assessed quantitatively by 10 (ten) junior high school science educators. The results were analyzed by researchers using the Lawshe formula, obtained an average CVI (Content Validity Index) of 0.99. This means that the collaboration skills rubric is by the

underlying theory and the level of thinking and can measure the science-based collaborative skills of students in junior high school science learning.

Table 5. Calculation Results of the Lawshe Formulas for Collaborative Skills Rubric

Aspects of Collaboration Skills	Statement Item	CVR	Information
Contribution	1-4	0.99	Very Valid
Time management	5-8	0.99	Very Valid
Work quality	9-12	0.99	Very Valid
Fixers	13-16	0.99	Very Valid
Synthesis	17-20	0.99	Very Valid
Attitudes and behaviour	21-24	0.99	Very Valid
Focus on work	25-28	0.99	Very Valid
Preparation	29-32	0.99	Very Valid
Pride	33-36	0.99	Very Valid
Monitor group effectiveness	37-40	0.99	Very Valid
Work with other people	41-44	0.99	Very Valid
Investigation technique	45-48	0.99	Very Valid
CVI average		**0.99**	**Very Valid**

The validation of the response questionnaire for the practicality test was carried out on two experts, the results obtained an average of 3.69 with very valid criteria. This means that the response questionnaire can be used in a limited practicality test (the initial field trial stage) through the teacher response questionnaire to the collaboration skills rubric. It is important to do a practical test in developing a product in the form of an instrument, to know the ease or difficulty that might be found in the instrument. According to Hsin-Ke L and Peng-Chun L[23] practicality is aimed at the "friendliness" of an instrument in its implementation. The practicality of the assessment instrument is the ease with which the assessment instrument is prepared, used, interpreted, and stored [24](Dimyati &Mudjiono,2013) (Rogier,2014)[21].. A total of 8 (eight) junior high school science teachers were asked to fill out a response questionnaire. The results of the limited practicality test showed that the total positive response was 92.55%. This means that the collaboration skills rubric is categorized as easy to understand, learn, and use, and is not burdensome in terms of cost and time.

Table 6. Percentage of Educators' Responses to Collaboration Skills Rubric (Limited Trial)

No.	Statement	% Positive Response
1	The instructions for using the collaboration skills rubric are easy to understand	84.50
2	How to use the collaboration skills rubric is easy to learn	87.50
3	Every aspect of the rubric criteria is easy to understand	93.75
4	Assessing your own collaboration skills is not difficult	90.75
5	The assessment rubric used details each criterion so that it is easy to provide an assessment.	90.75
6	The language used in the assessment of collaboration skills is simple / clear / easy to understand	90.75
7	I don't feel overwhelmed by the costs associated with using collaboration skills assessments	100.00
8	I feel like I don't spend a lot of time on assessing collaboration skills	93.75
9	The design of the rubric for assessing collaboration skills is neat and attractive	93.75
10	I want this collaboration skills assessment rubric to be applied in science learning	100.00
	Average	92.55

Limited practicality test results are used to make improvements to the rubric of collaborative skills (revision of trial results stage). The instructions for using the questionnaire were improved by making more specific instructions, namely making general instructions and specific instructions. Besides, before filling in the questionnaire, an explanation will be made to the respondent about the rubric. Furthermore, the practicality test was carried out extensively (field trial phase) on 15 (fifteen) science educators, the results are in 'Table 7'.

Table 7.Percentage of Educator Responses to Collaboration Skills Rubric (Widespread Trial)

No.	Statement	% Positive Response
1	The instructions for using the collaboration skills rubric are easy to understand	100.00
2	How to use the collaboration skills rubric is easy to find	100.00
3	Every aspect of the rubric criteria is easy to understand	96.75
4	I find it easy to assess self-collaboration skills	96.75
5	The assessment rubric used details each criterion so that it is easy to provide an assessment.	95.00
6	The language used in the assessment of collaboration skills is simple / clear / easy to understand	93.25
7	I don't feel overwhelmed by the costs associated with using collaboration skills assessments	100.00
8	I feel like I don't spend a lot of time on assessing collaboration skills	95.00
9	The design of the rubric for assessing collaboration skills is neat and attractive	96.75
10	I want this collaboration skills assessment rubric to be applied in science learning	100.00
	Average	97.35

Extensive trials showed an increase in the percentage of positive responses compared to limited trials. A positive response of 97.35% was given by respondents to the collaborative skills rubric. Observers are said to have a positive response to the assessment tool if 50% of them give a positive response to at least 70% of the number of aspects being asked[25] (Sugiyono, 2016). The results of this practicality test concluded that the rubric for assessing collaboration skills was said to be practical.

4. Conclusion and suggestion

4.1 Conclusion
Collaborative instruments are feasible to be implemented to measure the collaborative skills of students because the results of the validity test obtained an average CVI (Content Validity Index) of 0.99 with very feasible criteria and a limited practicality test shows that the total positive response is 92.55%, as well as widely at 97.35%.

4.2 Suggestion
The instrument for measuring collaborative skills in science learning can be used as material for further research because this research has not yet reached testing the effectiveness of this instrument on other variables in learning. Furthermore, the collaborative assessment instrument developed is expected to be used in all other subjects in Junior High School, not just science, so that it becomes a standard rubric in Indonesia.

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