Development and Validation of Collaboration and Communication Skills Assessment Instruments Based on Project-Based Learning[1]

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Abstract

This study aim to describe the validity, practicality and effectiveness of the assessment instrument of collaboration and communication skills based on Project-Based Learning. The development design used the Research and Development method with the development model of Borg and Gall that is limited only 7 steps of development. The number of small group trial subject was 32 students and the number of wider trial subject was 102 students in Physics classroom. The result of the study show that the assessment instruments of collaboration and communication skills based on project-based learning was valid in terms of construction, substance and language after expert testing with a slight revision. In the small group test the instrument was practical, and effective while in the broad group test each item was reliable with the Cronbach's Alpha value self assessment instruments for collaboration and communication skills as a whole were 0.747 and 0.746 respectively.

KeyWords:

collaboration skill, communication skill, project-based learning, physics

[1] This study was produced from the first author's master's thesis

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INTRODUCTION

Regulation of the Minister of National Education of the Republic of Indonesia number 20 of 2016, concerning graduate competency standard for each graduate of primary and secondary education units which stipulated that student must have competencies in three dimensions namely attitudes, knowledge, and skills. In the skill dimension students are required to have the ability to think and act: creative, productive, critical, independent, collaborative and communicative. This shows the importance of 21st century skills for high school graduates. There are four abilities that students must possess in the 21st century, namely critical thinking and problem solving skills, communication skills, creativity and innovation, and collaboration (Afandi, Junanto, & Afriani, 2016; Softwan & Habibi, 2018). The 21st century skills that are important for students to have and develop are collaboration and communication skills. Collaboration skills are very important to be developed so that students can cooperate in group differences as a provision to face the era of globalization in the 21st century (Muiz *et al.* 2016).

Good communication skill is also very valuable skills in the world of work and everyday life. Communication skill includes skill in expressing thoughts clearly and persuasively both orally and in writing, the ability to express opinion using clear sentences, convey commands clearly, and can motivate others through speaking skills (P21, 2007a). Communication skill is one indicator that must be achieved in 21st century learning (Ongardwanich, Kanjanawasee, & Tuipae, 2015; Softwan & Habibi, 2018; Wijaya, Sudjimat, & Nyoto, 2016). Several studies had proven the importance of communication skill (Sheydaei, Adibsereshki, & Movallali, 2015; Wilhalminah, Rahman, & Muchlisah, 2017; Zechia, 2017). Collaboration and communication skills must be identified using appropriate assessment instruments. Therefore, the important thing that must be done by the teacher is to compile and implement appropriate assessment instruments during physics learning. Assessment instruments that can measure students' skills in collaborating and communicating.

Based on preliminary research conducted by researchers at Public Senior High School in Pringsewu District, Indonesia, teachers had not yet made an objective assessment to measure students' collaboration and communication skills. Assessment of students' skills during collaborating and communicating was only supported by the teacher's opinion so that the determination of the final value of the achievement of student learning outcomes is less objective. The teacher had not assessed the student's skills when collaborating and communicating using the rubric specifically because of several reasons including: (1) the lack of examples of instruments for collaboration and communication skills assessment; (2) The existing skills assessment instrument has not specifically measured collaboration and communication skills aspect as a whole; (3) assessment instruments used only use observation techniques so that teachers are less than optimal in observing students'

skills when collaborating and communicating. This is certainly detrimental to students who actually have potential in other aspects besides cognitive aspects. Furthermore, based on preliminary research conducted by researchers, 100% of teachers agreed if an assessment instrument is developed to detect student collaboration and communication skills (Noviana, 2018).

The assessment instrument of collaboration and communication skills can be used if the teacher carries out learning that involves students actively and creatively. With active learning students will be involved in activities that can train critical thinking, creativity, collaboration and communication skills. To make students have the skills to collaborate and communicate, the efforts are needed that can be applied to learning activities. These efforts can be carried out in various ways, one of which is by implementing a learning model that can support students' collaboration and communication skills. One of learning model that is considered capable of facilitating 21st century skills is a project-based learning model. The innovative learning model is suggested in the 2013 curriculum. The project-based learning (PjBL) model is the right learning model to train student collaboration and communication skills (Cameron & Carolyn, 2014).

This study aimed to develop a instrument for assessing collaboration and communication skills based on Project-Based Learning and to determine the level of validity, practicality and effectiveness. The skills assessment instrument that has been developed consists of several components, namely, the instrument grid, instrument items in the form of self-assessment sheets, rubrics, and scoring guidelines. Based on the literature review conducted by researchers, so far there has been no development of a instrument for evaluating collaboration and communication skills based on project-based learning. The skill assessment instrument that has been developed is the development of self-assessment instrument to assess students' cognitive aspects as a complement to formative assessment in physics learning (Wijayanti & Mundilarto, 2015). The other assessment instruments that have been developed are instruments that are oriented towards the process of student performance during problem-based learning developed for summative assessment. Assessment instruments that discuss four competence areas are: (1) participation and communication skills, (2) collaboration or team building skills, (3) comprehension or reasoning skills and (4) knowledge in gathering knowledge and information. The form of the instrument was developed in the form of an observation sheet so that it requires several observers to observe the work process of students (Sim, et al; 2006). The design of the collaboration ability rubric is adopted from many schollars (Hermawan, et al. 2017, Daud et al. 2016).

Methods

This study used development research by using several stages according to Brog and Gal (1989) namely : 1. *Research and information colletion*; 2. *Planning*; 3. *Develop Preliminary form of product*; 4. *Preliminary Field Testing*; 5. *Main Product Revision*; 6. *Main Field Testing*; 7. *Operational Product Revision*. Development stage includes *Research and information colletion*, *Planning*, *Develop Preliminary form of product*, While validation stage includes *Preliminary Field Testing*, *Main Product Revision*, *Main Field Testing*, *Operational Product Revision*.

Population and Sample

The population in this study consisted of 10 th grade high school students at Private and Public Senior High School, Pringsewu District, Indonesia (just called them of SM1 & SM2). The study involved the samples of 134 students. Sampling was done by purposive sampling technic.

Data collection was carried out in two stages, namely developing the collected data from questionnaires and interviews, while the validation was carried out by feasibility test, small group testing, and broad group testing using a questionnaire. The development phase includes the activities of Research and information colletion, Planning, Develop Preliminary form of product. The initial activity was conducting a preliminary study, conducting literature review and relevant research studies, observing and identifying the physics learning processes, and learning outcomes assessment used. To get an illustration about the implementation of learning and the difficulty of the teacher in conducting the assessment. The information obtained was used to refine the draft of the development of the assessment draft. The next activity was formulating, scoring guidelines, instrument grids, and rubrics. The development stage resulted prototype 1.

The design resulted at development stage, then carried out a feasibility test by 5 experts, analysis and first revision that resulted a prototype 2. The results of the analysis then carried out a small group trial to see student responses and product effectiveness. The subjects of the small group trial were the 11th grade students of SM1 as many as 32 students. Furthermore, the results of the trial were analyzed and revised, it resulted in a tentative model. The expanded trial was carried out on 11 th grade students at SM2 after performing project assignments. The trial was expanded to see the item's validity and reliability statement, effectiveness and practicality. The results of the trial were expanded, then analyzed and revised. Based on the results of this trial, an analysis was carried out using SPSS program to see the validity and reliability of each statement. To see whether the instrument developed effectively is used, the effectiveness of using the SPSS program was tested. Extensive group trials were also conducted to determine the response of students and teachers about the practicality of the instruments developed.

Product trial design to determine the effectiveness of PjBL-based collaboration and communication skills assessment instruments using Before and after without

control design. The experiment was carried out on the same class by comparing the pretest and posttest values, namely the value of collaboration and communication skills before and after carrying out project tasks. Before and after without control design are presented in Figure 2 .

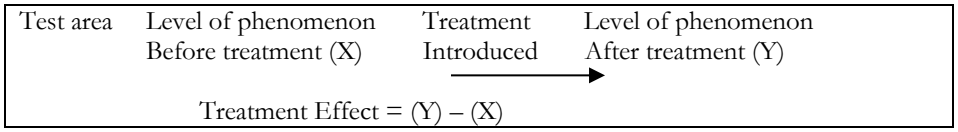

Figure 2.

Before and after without control design (Kothari, 2004)

Description :

X : Assessment value before performing project

Y : Assessment value after performing project

Data Analysis

Construct , substance and language validity was used to see the validity of see all instruments. It used the following formula.

$$X_{in}\% = \frac{\sum S}{S_{maks}} \times 100\% \quad \text{(Sudjana, 2005)}$$

Description : $X_{in}\%$ = answer percentage of I-th questionnaire.

$\sum S$ = Total answer value

S_{maks} = Maximum value expected

Calculate the average percentage of questionnaire to determine the feasibility, assessment instruments for collaboration and communication skills with the following formula

$$\overline{X_i\%} = \frac{\sum X_{in}\%}{n} \quad \text{(Sudjana, 2005)}$$

Description : $\overline{X_i}\%$ = average percentage of I-th questionnaire

$\sum X_{in}\%$=Total I-th percentage

n = The number of questions

Scoring respondents' answer in the feasibility, practicality and effectiveness test of the instruments based on the Likert scale (Sugiyono, 2015)

Table 1.
Assessment Value to Answer Choice

Answer Choice	value
Very Good	4
Good	3
Less Good	2
Very Bad	1

Change average value to be value with criteria according to (Sudjana 2005), it can be seen in table 2.

Table 2.
Average Value Criteria

Achievement Level	Qualification	Description
3,26 – 4,00	Very Good	Not need to be revised
2,51 – 3,25	Good	Revised as needed
1,76 – 2,50	Less Good	Major revised
1,01 – 1,75	Not Good	Totally revised

Interpret overall percentage value using interpretation (Sugiyono, 2015):

Table 3.
Percentage Value Criteria

Value (Percentage)	Criteria
80,1%-100%	Very High
60,1%-80%	High
40,1%-60%	Medium
20,1%-40%	Low
0,0%-20%	Very Low

RESULTS

The results of expert validation to assess the assessment instruments for collaboration and communication skills can be seen in Table 4.

Table 4.

The Results of Expert Validation Test

No	Aspect	Percentage of Validator value					Average	Criteria
		1	2	3	4	5		
1	Construction	89%	78%	80%	83%	72%	81%	Very High
2	Substance	86%	75%	88%	98%	70%	83%	Very High
3	Language/Culture	100%	83%	83%	100%	75%	88%	Very High

The results of the analysis in Table 4 showed that all aspects had been validated by 5 experts, it means that the instruments were valid in terms of construction, substance and language with small revisions. The percentage of the average value for all aspects of the value above the value range was in the very high category. Thus, it can be concluded that based on the validator's assessment, all aspects were in a very high category. Then, a small group test was conducted to determine the practicality and effectiveness of the product as a result of expert validation before being tested to a wider group. Practicality and effectiveness tests can be seen in Table 5 and Table 7.

Table 5.

Average Student Response

Instrument	N	Mean	Percentage	Criterion
Collaboration and Communication Skills	32	2,75	68,75%	High

The analysis results in Table 5 shows the high practicality product had student response of 2.75.

The effectiveness test in small groups was obtained by using statistical tests, which begins with the normality test of data using one sample Kolmogrov-Smirnov. The results of the normality test using statistical tests can be seen in Table 6.

Table 6.

Normality Test Results

No	Skill	N	*Mean*		*Asymp Sig.* (2- *tailed*)	
			Pretest	posttest	Pretest	posttest
1	Collaboration	32	2,4312	3,1588	0,112	0,519
2	Communication	32	2,4024	3,2023	0,911	0,891

Based on the results of one sample Kolmogrov-Smirnov's , significance value (2 tailed) was obtained for pretest and posttest on collaboration and communication skills that was greater than 0.05, it means that samples were obtained from

populations that were normally distributed. Therefore the next analysis must use the parametric test. The parametric test used was paired sample t-test. The results of paired sample t-test on collaboration and communication skills can be seen in Table 7.

Table 7.
T-test Sample Paired Test Results

No	Skill	N	Difference between Pretest-Posttest	*Asymp Sig.* (2- *tailed*)
1	Collaboration	32	0,7275	0,000
2	Communication	32	0,7999	0,000

The results of Paired Sample T-Test for collaboration and communication skills showed the Sig. (2-tailed) = 0,000 <0.05. This result indicated that the instrument valid for effective assessment of collaboration and communication skills measurement.

The following is the example of the statements in self-assessment assessment for measuring student collaboration and communication skills.

Table 8.
Self-Assessment Instrument for Collaboration and Communication

Skill Aspect	Statement
Collaboration	
1. Contribution	I give ideas clearly based on literature study related to project design
2. Time management	I know the assignments in groups, when collecting literature that does not cause groups to extend work time
3. Research techniques	I record information from various sources such as books and internet in detail regarding project design
Communication	
1. (*Openness*)	I discuss with my friends to compose the idea of illustration/the initial design of the product to be made
2. (*Empathy*)	I become a good listener when my friend gives an opinion about illustration / the initial design of the product to be made
3. Support	I help clarify the opinion of friend related illustration / initial design of the product to be made
4. *(Positivenes)*	I ask the opinion related to illustration / preliminary design of the product to be made
5. *(Equality)*	I am comfortable when discussing with friends regarding the initial product design product to be made

The next step was to conduct a broad group test. The broad group test was conducted to see the validity of each item and the reliability of the instrument.

Instrument reliability was calculated using Cronbach's Alpha formula, the results of reliability calculation can be seen in Table 8.

Table 8.

Reliability Test Results

Assesment	N-Item	Cronbach's Alpha
Collaboration	57	0.747
Communication	25	0.746

The reliability value of assessment instruments for self-assessment of collaboration skills and communication of extensive group trials were 0.747 and 0.746, it can be concluded that all statement in the self-assessment instrument for collaboration and communication skills was reliable.

Effectiveness of the appraisal of the development results is also seen through increasing pretest value with posttest in a broader group trial using statistical test. The results of the statistical hypothesis test using the Wilcoxon test, this is because the data were not normally distributed. The results of the normality test can be seen in Table 9.

Table 9.

Normality Test of Wider Group

No	Skill	N	Mean		Asymp Sig. (2-tailed)	
			Pre test	Post test	Pre test	Post test
1	Collaboration	102	2,5510	3,0890	0,010	0,060
2	Communication	102	3,0545	3,2212	0,023	0,000

Based on the results of one sample Kolmogrov-Smirnov's one output, significance values (2 tailed) were obtained for collaboration and communication skills that were smaller than 0.05, it means that samples were obtained from not normally distributed population. Therefore further analysis must use a nonparametric test. One of nonparametric test is Wilcoxon test. The results of the Wilcoxon test on collaboration and communication skills can be seen in Table 10.

Table 10.

The Results of Wilcoxon Test

No	Skill	N	Asymp Sig. (2- tailed)
1	Collaboration	102	0,000
2	Communication	102	0,000

Based on Table 9, the results of the Wilcoxon Signed Rank analysis obtained asympt sig (2 tailed) of 0,000. Because the asymp value was sig (2-tailed) $<\alpha$ (0.05), there was a difference between the mean values of the pretest and posttest.

The trial of product usage in a broad group was given to 11th grade students of SM2 which amounted to 102 students to find out students' responses to the

practicality of the products developed. The results of the average student response to a broader group can be seen in Table 11.

Table 11.

Average Response of Student of Wider Group

Instrument	N	Mean	Percentage	Criterion
Collaboration and Communication Skills	102	2,64	66,03%	high

Based on Table 11, the average score of 102 students of class XI SM2 about the performance of the response to the use of self-assessment instruments for collaboration and communication skills had a high degree of practicality. Conclusion obtained from questionnaires about student responses are assessment instruments using language and sentences that are easy to understand, the selection of fonts, sizes and spaces is correct, the display of assessment instruments was not boring and not too many aspects were observed.

Practical testing in broad groups was also given to teachers who have used the instruments of collaboration and communication skills assessment. The teacher filled out the questionnaire on the conformity, convenience and expediency of the instrument use. The results of filling out the questionnaire for Teacher responses can be seen in Table 12.

Table 12.

Average Percentage of Teacher Response

No	Teacher code	Average value Percentage		
		Conformity Test	Convenience Test	Expediency Test
1	A	93,0 %	83,0%	75,0%
2	B	88,0 %	75,0%	94,0%
3	C	80,0 %	91,7%	81,3%
4	D	87,5%	91,7%	75,0%
5	E	85,0%	91,7%	81,3%
6	F	80,0%	87,5%	87,5%
7	G	82,5%	87,5%	81,3%
8	H	85,0%	91,7%	81,3%
9	I	87,5%	87,5%	81,3%
10	J	87,5%	79,2%	81,3%
Average value		85,5%	86,7%	81,8%

The application test given to the teacher aimed to find out the teacher's response to the practicality of the instrument for the evaluation of development. The average

score of 10 Teachers regarding suitability, ease and benefit test had an average score with a very high practicality category.

Discussion And Conclusion

Based on the results of the analysis, it showed that the benefits of self-assessment (self assessment) that encourages students to have a sense of responsibility towards the learning process, so students can be independent and practice evaluation skills that are useful for the next learning process (Crawford, *et al:* 2005). Giving feedback is one of the factors that greatly impacts the process of student learning success (Heitink, *et al:* 2016). (Abbdurahman, *et al:* 2018) revealed that active learning is very dependent on feedback. Self-assessment can provide feedback from the learning process (Crawford, *et al*: 2005). From opinions above, it can be concluded that self-assessment is a continuous and practical assessment process used in active learning as feedback from the learning process. So, it can be concluded that the instruments for collaboration and communication skills based on project based learning are valid, practical, and effective. This is supported by the opinion of Wusko, *et al* (2016) & Hasana, *et al* (2017) which revealed that the assessment developed is feasible if the developed assessment is valid, practical, and effective.

Based on the data analysis and discussion, it can be concluded that: The assessment of collaboration and communication based on project based learning was valid in construction, substance, and language based on expert testing. The assessment instrument consisted of instrument grids, self assessment sheets, rubrics, and scoring guidelines. The validity of the instruments for collaboration and communication skills based on Project-Based Learning was very good and feasible in construction, substance and language with a very high level of validity so that the instrument can be used. All statement in the self-assessment instrument for collaboration and communication skills were declared reliable, with Cronbach's Alpha 0.747 and 0.746. The practicality of the project based learning collaboration and communication skills assessment instruments from the results of small group and broad groups trials had a high practicality response.

Furthermore, the effectiveness of project-based learning collaboration and communication skills assessment instruments based on asympt sig values (2 tailed) for collaboration and communication skills was 0,000 $<\alpha$ (0.05). From the results of the improvement of student collaboration and communication skills, it was shown that the instruments for effective collaboration and communication skills based on project based learning were used to measure student collaboration and communication skills. Based on the results of the study it can be concluded that the instrument for collaboration and communication skills based on project based learning was valid, practical and effective. However, the new instruments in its

implementation requires intensive scaffolding practices from the teacher, especially if used as an assessment for learning (Nurulsari *et al*: 2017).

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