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Development of an Assessment Instrument to Measure High School Students' Collaboration Skills in Physics Learning

Nadia Natalia Simamora[a)], Edi Istiyono[b)], Insih Wilujeng[c)]

Universitas Negeri Yogyakarta, Jl. Colombo Yogyakarta, Depok, Sleman, Daerah Istimewa Yogyakarta 55281, Indonesia

✉: [a)]nadianatalia.2022@student.uny.ac.id, [b)]edi_istiyono_uny@yahoo.co.id, [c)]insih@uny.ac.id

Abstract

This study aims to determine the feasibility of the instrument for assessing students' collaboration skills in learning physics. This research is Research and Development (R & D) research with the Analysis, Design, Development, Implementation and Evaluation (ADDIE) model. In this research, the researcher limited the stages in the ADDIE model to the development stage only, so that the development research stages were reduced from five steps to three steps, namely analysis, design and development. The population in this study were students of SMA Negeri 1 Piyungan with a sample of 25 students. The instrument used is a questionnaire. The data obtained were analyzed using validity and reliability tests with the help of the SPSS application. The results obtained show that the validity value obtained is 1.00 with a very high validity category and the reliability value shown through the Cronbach's Alpha value of 0.927 is in the very high criteria. In the small group trial, an r_{table} value of 0.396 was also obtained, and the r_{count} value was in the range of 0.425 – 0.760. From these results it shows that the instrument for assessing students' collaboration skills in learning physics is valid and feasible to use.

Keywords: assessment instruments, collaboration skills, physics learning

INTRODUCTION

Education is an important asset for the sustainability and progress of a nation, especially for preparing a generation that is able to compete in the 21st century with quality and skills (Mardhiyah et al., 2021; Sole & Anggraeni, 2018). Important skills in the 21st century that are relevant to the pillars of life include learning to know, learning to do, learning to be, and learning to live together. These skills are 21st century skills which consist of critical thinking skills, creativity, communication and collaboration (Bariyyah, 2021; Valtonen et al., 2021). It can be seen that one of the important skills that students have is collaboration skills.

Collaboration skills are the ability to work together in a team to achieve common goals (Demetroulis et al., 2023). These skills include the ability to communicate effectively, listen actively, build good relationships, manage conflict, and contribute to a team (Hidayah & Ibrohim, 2019). Collaboration capabilities can develop harmonious relationships with group members, share information and resources, develop innovative and effective strategies and solutions (Baumeister et al., 2018; Hazelkorn et al., 2022). To achieve learning goals successfully requires effective teamwork between students and good relationships with fellow students, so it is important for each student to develop collaboration skills.

Collaboration skills possessed by students can improve social and interpersonal skills, communication skills, critical and creative thinking skills, motivation and learning engagement, as well as increasing academic achievement. Increasing social and interpersonal skills makes students learn to work together in groups and learn to understand other people's perspectives, as well as learn to appreciate differences and resolve conflicts positively (Kehoe et al., 2018). Through collaboration skills, students learn to communicate effectively and listen actively to achieve common goals (Ghavifekr, 2020). Apart from that, students also learn to solve problems together and build knowledge together in groups, and create innovative solutions (Kwangmuang et al.,, 2021). Collaboration carried out by students in groups makes students feel more motivated and involved in learning, thereby helping students achieve better learning outcomes (Mora et al., 2020; Qureshi et al., 2023). It can be seen that collaboration skills provide various benefits in the learning process, of course these collaboration skills are also important for students to have in the Physics learning process.

Physics learning uses conceptual understanding and reasoning to solve problems and many research and projects require collaboration between teams (Aretz et al., 2016; Kaniawati & Kusairi, 2018). Collaboration between teams requires collaboration skills for each student. Collaboration skills are important in learning physics because they can increase understanding of physics concepts, where students can help each other in solving problems and explaining concepts to other group members (Gillies, 2020). Collaboration in physics learning can also help increase students' motivation and involvement in learning because they are given the opportunity to work together and contribute in groups (Tran, 2019; Vauras, Volet, & Bobbitt Nolen, 2019;). By working together in groups, students can question assumptions, look for alternatives, and create innovative solutions to understand concepts and solve physics problems (Tan, 2021; Graesser et al., 2018). Each student's collaboration skills can be identified by measuring them using assessment instruments. Assessment of collaboration skills is carried out using instruments. Instruments are tools used to measure and collect data or information in research and assessment (Arikunto, 2010). Instruments play an important role in determining the quality of research and assessment.

Research conducted by Hermawan et al. (2017) obtained a rubric design for junior high school students' collaboration skills in light reflection material which can be continued by future researchers. Then research conducted by Fitriyani et al. (2019) stated that students' high level collaboration and thinking skills increased by using a problem based learning model with good criteria. Then research conducted by Saldo & Walag (2020) stated that students' communication and collaboration skills had improved positively after using problem-based and project-based learning methods. The relevance of this research to this research is research on collaboration skills, but in this research what was carried out was the development of an instrument for assessing the collaboration skills of high school students in physics learning.

Based on this description, the researchers conducted research on "developing an assessment instrument to measure the collaboration skills of high school students in learning physics". This research aims to produce an instrument for assessing the collaboration skills of high school students in learning physics using research and development methods.

METHODS

Data Collection and Instruments

This research is research development or Research and Development (R&D). This research produced a product in the form of an assessment instrument for students' collaboration skills. Therefore, the assessment instrument developed uses assessment for learning, which is an assessment carried out during the learning process. The development model used is the ADDIE model. The ADDIE model has five stages including Analysis, Design, Development, Implementation, and Evaluation. In this study, the researchers limited the stages in the ADDIE model to the development stage only, so that the stages of development research were from five steps to three steps, namely analysis, design, and development. Researchers limit this research only up to the third stage because this development research is a small-scale research.

The population in this study were students of SMA Negeri 1 Piyungan. The research sample was taken using simple random sampling technique. Simple Random Sampling or commonly abbreviated

as Random Sampling is a sampling method in which each member of the population is given the same opportunity to be selected as a sample (Arieska & Herdiani, 2018). Then the test subjects in this study amounted to 25 students. The instrument used in this research is a questionnaire. The questionnaire consists of an instrument validation sheet for assessing student collaboration skills, and a questionnaire for student collaboration skills. The collaboration skills questionnaire grid can be seen in the following table.

TABLE 1. Student Collaboration Skills Questionnaire Grid

Aspect	Indicator	Item Number
Work Productively in a team	a. Contribute actively in the group	1,2,3,4
	b. Work collaboratively with different types of people	5,6,7,8
Shared responsibility in the team	a. Demonstrates shared responsibility for completing projects or group assignments	9,10,11,12
	b. Project management: Planning, executing, and evaluating group projects or group assignments	13,14,15,16
Flexibility and compromise within the team	a. Demonstrate willingness to cooperate, accept suggestions and decisions together	17,18,19,20
	b. Show respect for a friend or team	21,22,23,24,25,26

Data Analysis

The data in this study were analyzed quantitatively. The instrument for assessing student collaboration skills was validated by 2 validators which were then analyzed using the Gregory test to see whether or not the instrument was feasible to use. The Gregory test equation can be written as follows (Chonstantika, 2012).

$$V_i = \frac{D}{A + B + C + D}$$

You can also use a 2×2 cross tabulation as TABLE 2.

TABLE 2. Cross Tabulation

		Validators 1	
		Not enough Relevant Score 1-2	Very Relevant Score 3-4
Validators 2	Not enough Relevant Score 1-2	0	10
	Very Relevant Score 3-4	0	10

Information:

- V_i = Content validation
- A = Cells showing disagreement between the two validators
- B = Cells showing approval validator 1 agrees, validator 2 disagrees
- C = Cells showing approval validator 1 disagrees, validator 2 agrees
- D = Cells indicating valid agreement between the two validators

Conclusions are made with content validity criteria which can be seen in the following table.

TABLE 3. Content Validity Criteria

Range Score	Category
0.8 – 1.00	Validity Very High
0.6 – 0.79	Validity High
0.4 – 0.59	Validity Currently
0.2 – 0.39	Validity Low
0.00 – 0.19	Validity Very Low

Instrument reliability was measured using the Alpha-Cronbach formula with the help of the SPSS application. The level of consistency of the reliability of an instrument can be seen in the following table.

TABLE 4. Reliability Criteria

Intervals Score	Degrees Consistent
0.00 – 0.20	Reliability Very Low
0.21 – 0.40	Reliability Low
0.41 – 0.60	Reliability Currently
0.61 – 0.80	Reliability High
0.81 – 1.00	Reliability Very High

Data obtained from small group trials were analyzed using the SPSS application to calculate the validity coefficient for polytomous item scores using product moment correlation (r).

RESULTS AND DISCUSSION

The research and development carried out obtained results, namely an instrument for assessing students' collaboration skills in learning Physics, especially in straight motion material. Collaboration skills assessment instruments have been designed according to the needs of students. The instrument was validated by 2 experts, namely D.A and F.Y. The validation results of the 2 validators can be seen in the following table.

TABLE 5. Result Validity

No.	Aspect	Indicator	Validators		Info.
			I	II	
1.	Format	Include charging instructions questionnaire Which clearly stated	4	4	D
		Include title questionnaire was clear	3	4	D
		Type and font size in accordance	3	4	D
		Arrangement space/organization location/numbering was clear	4	4	D
2.	Fill	The statements presented in questionnaire clear And easy understood	3	4	D
		Provide column evaluation with clear and neat	4	4	D
		Statements in the questionnaire is enough to represent student response to Skills participant collaboration educate will researched	3	3	D
3.	Language	Language and term which used in questionnaire response participant educateeasy understood	4	3	D
		The language used is correct and use instructions/instructions was clear so that no double interpretation	4	3	D
		Language characteristic is used communicative and appropriate for participantseducate	4	3	D

Based on TABLE 5, in the format aspect with 4 indicators, results were obtained showing valid agreement between the two validators with the description "D". Furthermore, in the content aspect with 3 indicators, the results of valid agreement between the two validators were obtained with the description "D". Then in the language aspect, 3 indicators show the results of valid agreement between the two validators with the description "D". The three aspects of the assessment of the collaboration skills assessment instrument show valid agreement between the two validators with the description "D". This is supported by the validity value obtained from calculations using the equation in the Gregory test of 1.00. This means that the collaboration skills assessment instrument items are at very high validity criteria.

The validity test of the collaboration skills assessment instrument was carried out, followed by a reliability test. The reliability test of the collaboration skills assessment instrument was carried out with the help of the SPSS application. The results of the instrument reliability test can be seen in TABLE 6.

TABLE 6. Reliability Test Results for Collaboration Skills Assessment Instruments

Reliability Statistics	
Cronbach's Alpha	N of Items
0.927	26

Based on TABLE 6, it can be seen that the reliability test results for the collaboration skills assessment instrument are 0.927. These results are based on TABLE 4 which contains the reliability criteria which are at very high reliability criteria. This means that the instrument for assessing student collaboration skills is reliable in the very high category.

The instrument for assessing students' collaboration skills was declared valid by experts with a validity value in the very high category and reliable with a Cronbach's Alpha value in the very high criteria. The collaboration skills assessment instrument was then tested on 25 students. The results of the small group trial were analyzed using the SPSS application to obtain an rtable value of 0.396, and the calculated rvalue was in the range 0.425 – 0.760, these results showed that all statement items were declared valid.

The collaboration skills assessment instrument developed consists of 3 aspects, including working productively in a team, shared responsibility in a team, and flexibility and compromise in a team. The aspect of working productively has 2 indicators, including contributing actively in groups with 4 statement items, and working collaboratively with various types of people with 4 statement items. The aspect of shared responsibility in the team consists of 2 indicators, including showing joint responsibility for completing projects or group tasks with 4 statement items, and project management: Planning, implementing and evaluating group projects or group tasks with 4 statement items. Then the aspect of flexibility and compromise in the team consists of 2 indicators, including showing a willingness to work together, accepting suggestions and joint decisions with 4 statement items, and showing respect for friends or teams with 6 statement items. The collaboration skills statement item that was developed has been declared valid by experts with a Gregory test result value of 1.00 which is supported by small group test results for students who obtained an r-table result of 0.396, and the calculated r-value is in the range 0.425 – 0.760 which indicates that all statement items are declared valid.

The instrument for assessing collaboration skills of high school students in physics learning has been declared valid and suitable for use. The collaboration skills assessment instrument developed can be used by teachers or researchers to measure students' collaboration skills in physics learning. It is important to assess students' collaboration skills in learning to determine the development of students' collaboration skills. Assessment in learning is an effort to obtain information about student development during learning which is useful as material for teachers in making decisions about these students (Imania and Bariah, 2019). When students have a low level of collaboration skills, teachers must take action to improve students' collaboration skills. However, if students' skills are classified as good, the teacher must create a learning plan that can maintain and improve students' collaboration skills.

Students' collaboration skills that are classified as good can improve their ability to interact and communicate with others effectively, understand each other, consider each other, and build mutually beneficial partnerships to achieve common goals (Li et al., 2023; He et al., 2021). Collaboration skills can also improve problem-solving skills. By working together in groups students can learn to solve problems collaboratively, which can help them develop this skill (Haugland, 2022; Saputra et al., 2019). Collaboration skills can also improve critical and creative thinking skills. Critical and creative thinking skills are essential for understanding concepts and solving problems. By working together in groups, students can question assumptions, look for alternatives, and create innovative solutions (Graesser et al., 2018). Collaboration skills possessed by students can also increase students' understanding of physics concepts, where students work together in groups to understand difficult or abstract physics concepts.

Research conducted by Richardo (2023) shows that the application of STEM-based learning can improve 21st century skills, especially collaboration skills, very well. Then research conducted by Stephanie & Erin (2019) states that efficiency in collaboration skills has an impact on increasing knowledge construction and problem solving. Then research conducted by Novianti et al. (2022) regarding the development of learning media for the ludo physics game on the subject of optical instruments which can increase student collaboration in the quite collaborative category. Based on previous research, it can be seen that collaboration skills can be improved through the learning model and learning media used. The collaboration skills assessment instrument developed has been declared valid and suitable for use by future researchers to measure students' collaboration skills. When researchers develop learning media to improve collaboration skills, this assessment instrument can be used as a measuring tool to determine students' collaboration skills.

CONCLUSION

The collaboration skills assessment instrument developed can be used to measure students' collaboration skills in physics learning. The instrument developed obtained validity and reliability scores in the high category. The validity value obtained was 1.00 in the very high validity category and the reliability value indicated by the Cronbach's Alpha value of 0.927 was in the very high criteria. In the small group trial, an rtable value of 0.396 was also obtained and the calculated rvalue was in the range 0.425 – 0.760. The results show that all statement items are declared valid. So the instrument for assessing students' collaboration skills in physics learning is valid and suitable for use. The collaborative skills assessment instrument developed can be used as a tool to measure the collaboration skills of high school students in physics learning. This research only develops an instrument for assessing the collaboration skills of high school students, so that future researchers can use this research as a reference in further research or can use this research as part of the research that will be carried out.

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