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Online Performance Assessment Based on Science Process Skills and Collaboration Skills in Islamic Religious Higher Education

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ABSTRACT

4C skills (critical thinking, creativity, collaboration, communication) are essential in modern education. The existing assessment instruments are not fully integrated with technology. This research develops technology-based instruments to assess 4C skills. This study aims to determine experts' opinions on the feasibility and practicality of an online performance assessment instrument based on science process skills and collaboration skills. The research used the R&D method with the ADDIE development model. The subjects of the study were students from UIN Raden Intan Lampung, UIN Walisongo, and IAIN Cirebon with 60 students. The data collecting techniques used were questionnaires for expert validation on the content and language of the questions. The researcher also distributed questionnaires to the students. The findings of this study are 1) the final product meets the high feasibility criteria with a percentage of 88% for the content aspect and 86% for the language aspect, 2) the practicality of the product meets the excellent criteria, and 3) the response of the teachers indicates that the product is highly feasible. As a physics learning product in laboratory activities, the online performance assessment instrument with science process skills and collaboration skills is suitable and practical to use. It is recommended for other researchers to utilize other online platforms and instruments to measure other skills.

INTRODUCTION

Assessment plays a crucial role in the learning process as it provides valuable insights into students' performance and progress (Rosidin, 2017; Renò et al., 2022). Generally, assessment is used to evaluate students' abilities in discussions, problem-solving, laboratory work, and other observable activities (Clark & Watson, 2019; Sudjana, 2010). Adri et al. (2022) highlight that assessing students' psychomotor skills can be effectively done by observing their actions, aligning with the approaches discussed by Palm (2019) and Sassanelli et al. (2019). Rosidin (2016) explains that performance assessment is a form of authentic evaluation in which students showcase their abilities by applying their skills and knowledge (Arikunto, 2018).

Currently, education has undergone significant transformation with the rapid development of the Internet. The increasing use of the Internet has had a major impact on the modern education system. Terms, such as mobile learning (M-Learning), E-Learning, Kahoot, Massive Open Online Courses (MOOCs), and Socrative are new ways of learning and assessing students through online platforms (Ayoub et al., 2020; Khairil & Mokshein, 2018). For example, (Wahyuni, 2015) conducted research on the development of web-based performance assessments for science subjects, showing positive responses from students. Other studies have also found that students have a positive attitude and knowledge when using performance-based assessment in the learning process (Back & Hwang, 2005;

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Kwamina Arhin, 2015; (Sumiyati et al., 2019).

In addition to influencing assessment techniques, the development of ICT also affects important skills that students need to have. The skills that are currently highly needed are process skills and collaboration skills. Process skills are very important in today's era due to the many complex problems that need to be solved. The ability to observe, formulate hypotheses, design and conduct experiments, analyze data, and draw conclusions based on empirical evidence will be very useful in solving these problems. In addition, with process skills, one can make discoveries, update existing knowledge, and develop better technologies (Alfama Zamista & Kaniawati, 2015).

Meanwhile, collaboration skills have also become very important for students to have in this era due to the increasing number of jobs that require teamwork and effective communication (Hairida et al., 2021; Le et al., 2018). Collaboration skills can also help someone to lead and follow, thus increasing team productivity and achieving common goals more effectively (Le et al., 2018).

Based on field surveys conducted through interviews and questionnaires distributed to physics education lecturers and lab assistants at UIN Raden Intan Lampung, UIN Walisongo, and IAIN Cirebon, it was found that 81.21% stated the absence of appropriate and feasible performance assessment instruments for assessing students during physics basic course laboratory activities. This finding indicates that the assessments conducted have not yet referred to the competency skill assessment standards, both general and specific skills, as stipulated in Permenristekdikti no 44 of 2015.

Furthermore, the existing instruments do not require students to have science process skills and collaboration skills. However, both of these skills are very important for students as prospective physics teachers. In line with (Agus Kurniawan et al., 2020; Darmaji et al., 2018), as a prospective educator, one must have science process skills. Therefore, pre-service physics teachers should be facilitated with laboratory work that uses performance assessment based on science process skills and collaboration skills.

So far, studies on the development of performance assessment instruments to measure science process skills (Agustiani et al., 2022) and collaboration skills are still partially conducted. In line with the findings of (Rudianto et al., 2022), an assessment instrument for the 4C skills has been developed, but it has not been integrated with technology.

Considering the urgency of mastering science process skills and collaboration skills for pre-service physics teachers, the researchers feel it is necessary to develop an online performance assessment instrument based on science process skills and collaboration skills in the basic physics practicum course at Islamic higher education institutions.

METHODS

This study uses the research and development (R&D) method to produce and develop a product. The research procedure refers to the ADDIE model development design (Analysis, Design, Development, Implementation, and Evaluation) (Dick & Carrey, 1996). The development stages of the ADDIE model are presented in Figure 1.

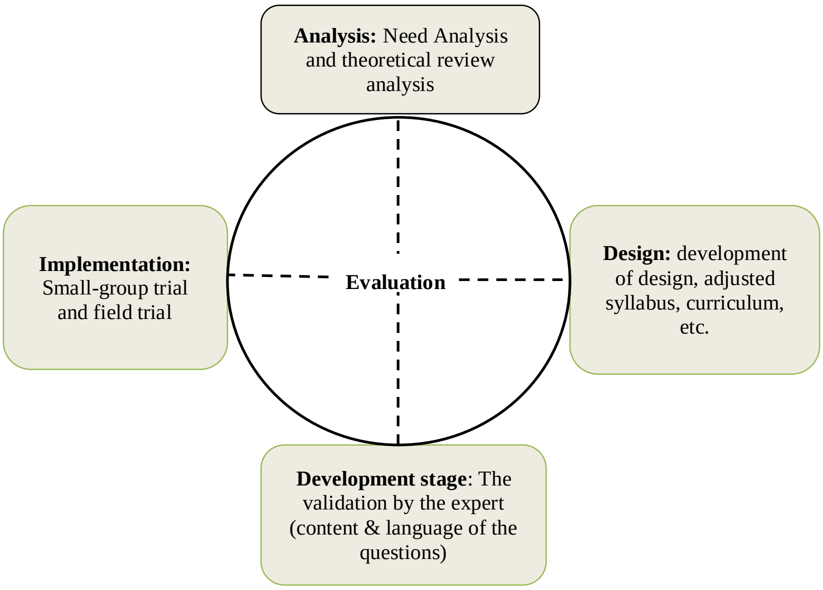

Figure 1. ADDIE Development Stage

This research was conducted at Islamic Religious Colleges that have Physics Education Study Programs in Lampung Province, namely UIN Raden Intan Lampung, and outside Lampung Province, namely UIN Walisongo and IAIN Cirebon. The subjects involved consisted of 60 subjects. The expert validators consisted of six experts. The research was conducted from January to October 2022.

The instruments used in this study were expert validation questionnaires to describe the quality of the developed product. The questionnaires consisted of material and language expert validation instruments, as well as questionnaires on the response of lecturers and students towards the developed product. The developed product is an online performance assessment instrument based on science process skills and collaboration skills in basic Physics practicum. The product testing includes small group testing and field testing.

RESULTS

This development research collected data from physics education lecturers and lab assistants at PTKI, namely UIN Raden Intan Lampung, UIN Walisongo, and IAIN Cirebon, by developing a product based on the physics basic course curriculum, semester lesson plans, and the science process skills and collaboration skills indicators. In the development of the product, the researcher referred to the ADDIE development model, which consists of analysis, design, development, implementation, and evaluation.

1. Analysis Stage

The first stage of this development study is analysis, which involves two types of analysis: needs analysis and theoretical review analysis. The needs analysis was conducted by distributing questionnaires to physics laboratory assistants and conducting interviews with lecturers in the physics education program at t UIN Raden Intan Lampung, UIN Walisongo, and IAIN Cirebon. The findings indicate that the laboratory practicums have previously used performance assessment instruments to measure science process skills, but have not yet used performance assessment instruments to measure collaboration skills. The theoretical review analysis aimed to ensure that the developed instrument is not limited to a particular experimental material, but can be used for all experiments. The instrument was also designed to be aligned with both basic and integrated process skill indicators and collaboration skill indicators.

2. Design Stage

After conducting the analysis, the next step is the design phase. In the development of the design, it is adjusted to the syllabus, curriculum, RPS (Syllabus and Lesson Plan) of the Physics Education Study Program, as well as the indicators of science process skills and collaboration skills. The development of the online performance assessment tool was carried out through Google Forms in the design process.

The design stage was done by preparing the framework structure of the instrument, preparing the instrument grid, constructing performance assessment instrument and scoring rubric, writing the initial draft of the instrument, and inputting the instrument into Google Forms. At this stage, the researcher also prepared validation instruments and user response questionnaires. Below is the design of the performance assessment instrument developed after passing the analysis phase.

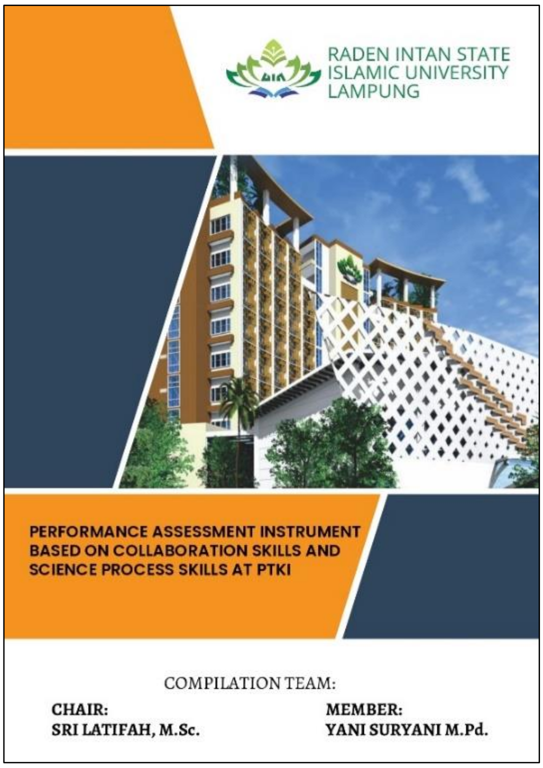

Figure 2. The Front Cover Display Before Adapting to the Google Form.

The collaboration skills assessment instrument specifications included several indicators, such as actively contributing with two question indicators and ten question items, working together productively with ten question items, being responsible with four indicator questions and ten question items, demonstrating flexibility into five question indicators and ten question items, and respect for others into three question indicators and ten question items. As a result, the total number of items for assessing collaboration skills was fifty (see Figure 3). The collaboration skills assessment sheet was equipped with instructions. It employed the four-option Likert scale rating scale (Figure 4).

The science process skills assessment instrument specifications consisted of indicators and sub-indicators. Indicators of science process skills covered observation, classification, measurement, space and time relationships, numbers, inference, communication, prediction, identification and variable control, data interpretation, hypotheses formulation, operational definition, and experimentation. The number of questions developed was 45 items (see Figure 6).

After the online performance assessment instrument was designed, the next step was to enter the statement items into the Google Form, which several validators would then validate. Validation sheets for the material and language experts were used to assess the instrument's feasibility. Material experts validated four aspects: presentation, construction, content quality, compatibility with semester plans, and collaboration skills. Furthermore, language experts validated three aspects: easy-to-understand language and terms, conformity with official Indonesian spelling, and communicative aspects appropriate for students.

3. Development Stage

In this development phase, the online performance assessment instrument is validated to ensure its suitability for use in the next stage. This validation was carried out by expert validators consisting of content experts and language experts. The results of the validation can be seen in Table 1 and Table 2.

Table 1. Material Expert Validation Results

No	Aspect	Percentage	Category
1	Presentation	91%	Highly feasible
2	Construct	89%	Highly feasible
3	Content quality	83%	Highly feasible
4	Conformity with the semester plans and collaboration skills	87%	Highly feasible
	Average	88%	Highly feasible

Table 2. Language Expert Validation Results

No	Aspect	Percentage	Category
1	easy-to-understand language and terms	84%	Highly feasible
2	conformity with official Indonesian spelling	90%	Highly feasible
3	communicative aspects	83%	Highly feasible
	Average	86%	Highly feasible

4. Implementation Stage

The next stage was the implementation for lecturers of basic physics courses and students, which was divided into two stages: small-group trial and field trial. The results are described in Table 3 – Table 5.

Table 3. The Results of Basic Physics Lecturers' Responses at UIN Raden Intan Lampung

No	Aspect	Percentage	Category
1	Conformity with the CPL & CPMK	84%	Highly feasible
2	Communicative	90%	Highly feasible
3	Presentation technique	87%	Highly feasible
	Average	87%	Highly feasible

Table 4. The Results of Basic Physics Lecturer Responses at UIN Walisongo

No	Aspect	Percentage	Category
1	Conformity with the CPL & CPMK	98%	Highly feasible
2	Communicative	100%	Highly feasible
3	Presentation technique	100%	Highly feasible
	Average	99%	Highly feasible

Table 5. The Results of Basic Physics Lecturers' Responses at IAIN Cirebon

No	Aspect	Percentage	Category
1	Conformity with the CPL & CPMK	91%	Highly feasible
2	Communicative	94%	Highly feasible
3	Presentation technique	95%	Highly feasible
	Average	93%	Highly feasible

After getting responses from the lecturers of basic physics courses from UIN Raden Intan Lampung, UIN Walisongo, and IAIN Cirebon, the average scores obtained for each aspect can be seen in Table 6.

Table 6. The Average Percentages of the Lecturer's Responses

No	Aspects	R1	R2	R3	Av.	Category
1	Conformity with the CPL & CPMK	98%	98%	91%	91%	Highly feasible
2	Communicative	90%	100%	94%	95%	Highly feasible
3	Presentation technique	87%	100%	95%	94%	Highly feasible
	Average				93%	Highly feasible

The results of the practicality of the instrument in the small-group trial and field trial are presented in Tables 7 and 8 below:

Table 7. The Results of the Small-Group Trial

No	Aspect	Percentage	Category
1	Practicality	84%	Highly feasible
2	Material strength	82%	Highly feasible
3	Presentation technique	83%	Highly feasible
	Average	83%	Highly feasible

Table 8. The Results of the Field Trial

No	Aspect	Percentage	Category
1	Practicality	88%	Highly feasible
2	Material strength	86%	Highly feasible
3	Presentation technique	87%	Highly feasible
Average		**87%**	Highly feasible

5. The Evaluation Stage

The evaluation aims to assess whether the online performance assessment tools developed by researchers have met initial expectations, such as the scientific process skills and collaborative skills.

DISCUSSION

In this study, an online performance assessment tool based on science process skills and collaboration skills was developed using Google Forms. This is similar to (Adhitya et al., 2022) research, which developed a critical and creative thinking assessment instrument based on Google Forms.

Based on the results of the pre-research conducted at the physics education program in Islamic Religious Universities (PTKI) such as UIN Raden Intan Lampung, UIN Walisongo, and IAIN Cirebon, it was found that not all lecturers used performance assessment instruments during laboratory activities. This problem is also the background for the researcher to develop an instrument that can be used to assess student performance online during laboratory activities, with a focus on process skills and collaboration skills.

The application of performance assessment instruments in laboratory practicum activities can be used to assess students' psychomotor skills on indicators of observing phenomena related to the material, identifying experimental tools and materials, formulating hypotheses, demonstrating experiments, writing observation results, analyzing observation results, drawing conclusions, and communicating observation results (Harahap, 2018). Performance assessment instruments can be used to assess students individually or in groups. Group practicum allows students to work together with group members, train cohesion to achieve experiment goals, and train students to interact and solve problems in an organized and caring manner with group members (Hairida et al., 2021b; Suryawan et al., 2015; Viyanti et al., 2022).

The next step is the design stage. The design stage is where the researcher designs the online performance assessment instrument, including developing the instrument framework, the instrument grid, the performance assessment instrument, the scoring rubric, the initial draft of the instrument product; and the Google Forms. The researcher also prepares a questionnaire for expert material teams consisting of four aspects: presentation, construct, content quality, and suitability of indicators for science process skills and collaboration skills. In addition to providing assessments, the researcher also includes a comment column for suggestions for improvement. This is done to achieve the research goals and meet the needs related to the online performance assessment instrument.

The third stage is the development stage, where the online performance assessment instrument is ready to be validated by experts in both content and language to obtain suggestions and improvements.

Although the presented performance assessment instrument can already be used as an assessment tool, some expert suggested to improve the science process skills and collaboration-based performance. This action is in line with the research of Connell et al., (2018) that it is important to conduct expert validation when conducting research.

After the performance assessment instrument has been validated by the material expert team and the language expert team, the next stage is the two-stage implementation by lecturers and students, namely the small group trial and field trial. The small group trial was are conducted by giving a questionnaire to physics education students at UIN Raden Intan Lampung through Google Forms and obtaining an average score of 83% (very practical category). After the small group trial resulted in the very practical category, it was then tested widely involving 118 students from three Islamic universities, namely UIN Raden Intan Lampung, UIN Wali Songo, and IAIN Cirebon. The field trial was conducted by distributing questionnaires to each student online via Google Form to determine the student's response to the practicality of the developed online performance assessment instrument, obtaining an average score of 87% in the very practical category. Based on the results of the student responses obtained from these three universities, it can be concluded that the science process skills and collaboration skills-based online performance assessment instrument is practical to use.

Based on the explanation, it can be concluded that the science process skills and collaboration skills-based online performance assessment instrument is very feasible and practical to use for assessing psychomotor aspects in laboratory work.

Many instrument developments have been conducted before, such as the development of web-based performance assessment in basic chemistry laboratories (Sari et al., 2018) and the development of web-based performance assessment in science courses (Wahyuni, 2015). In a related study, Schmid et al., (2020) successfully developed a valid and reliable short questionnaire (TPACK.xs) to assess Technological Pedagogical Content Knowledge (TPACK) and found support for a transformative perspective in the interaction of TPACK knowledge domains. However, the skills to be measured were not specifically examined.

Based on the results of the developed and validated online performance assessment instrument, the following benefits are known. This instrument can facilitate the lecturer in assessing performance during laboratory work, and it can be used to assess process skills such as observation skill, classification skill, measuring skill, formulated a hypothesis, etc. Also, collaboration skills such as contributing actively, working productively, being responsible, demonstrating flexibility, and others. Namaziandost et al. (2020) support this idea that that the use of e-portfolios or internet-based assessment tools, which produce useful assessment instruments, would be beneficial for both lecturers and students. One of the advantages for lecturers and students is to gain an accurate understanding of the assessment of collaboration skills and science process skills of students in the practicum process through factual data and provide convenience for lecturers or laboratory assistants to record scores automatically. The limitation of the online performance assessment instrument is that not all psychomotor aspects can be assessed using this instrument.

CONCLUSION

The online performance assessment tool based on science process and collaboration skills was created using the ADDIE development model. Based on the validation results from content and language experts, the developed product is deemed highly feasible. The response from the lecturers towards the online performance assessment tool is 93% with the highly feasible category. The response from the students in the small group trial and field trial is highly practical.

Therefore, the developed online performance assessment tool is feasible and practical to be used by lecturers and students during practical activities.

It is recommended that further research develop a performance assessment tool that can be used to evaluate various skills and utilize different online platforms.

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AUTHOR CONTRIBUTION

SL led the research design, execution, data collection, statistical analysis, and drafted the initial manuscript. YS played a significant role in the study design, data analysis interpretation, and provided critical revisions to enhance the manuscript's intellectual content. SS contributed to the development of visual tools and assisted in data collection.

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Appendix

COLLABORATION SKILLS ASSESSMENT INSTRUMENT LATTICE

Collaboration Skills Indicator	Problem Indicator	Item Number		Total
		Positive	Negative	
Contribute actively	a. Always express ideas, suggestions, or solutions in discussions b. Ideas, suggestions, or solutions expressed are useful in discussions	1, 2, 3, 4, 5, 6	7, 8, 9, 10	10
Work productively	Uses time efficiently by staying focused on the task without prompting and producing the required work.	11, 12, 13, 14, 15	16, 17, 18, 19, 20	10
Responsible	a. Know how to plan, organize, fulfill the tasks given by the Practicum Lecturer/Assistant and hold their respective duties. b. Consistently attend group meetings on time. c. Follow the orders that have become his duty. d. Not relying on others to complete their tasks.	21, 22, 23, 24, 25	26, 27, 28, 29, 30	10
Demonstrate flexibility	a. Accept the Joint decision. b. Accept appreciation, criticism and suggestions. c. Understand, negotiate, and take into account differences to achieve problem solving, especially in *multi-cultural* environments. d. Flexible in working together. e. Always compromise with the team to solve problems.	31, 32, 33, 34, 35	36, 37, 38, 39, 40	10
Respect for others	a. Respond with an open mind to different opinions and appreciate others' new ideas. b. Demonstrate a polite and kind attitude towards friends. c. Discuss ideas.	41, 42, 43, 44, 45	46, 47, 48, 49, 50	10

Appendix 1. Collaboration skills assessment specification

PERFORMANCE TEST / STUDENT PERFORMANCE TEST ASSESSMENT SHEET ON ASPECTS OF COLLABORATION SKILLS

Student/Respondent Identity
Name :
Department/Program :
Agency Origin:

INSTRUCTIONS:
A. Filling Instructions:
1. Fill in the respondent's / student's biodata first correctly.
2. Before filling out the statement, read the instructions carefully.
3. This questionnaire has 50 statement items that aim to measure student collaboration skills in basic physics practicum.
4. Give the right and honest answer according to your choice when collaborating / working together in groups by giving a *check* mark in the column of each statement item.
5. Make sure you don't miss any statements.

B. Answer Options Description
1 = Disagree
2 = Less Agree
3 = Agree
4 = Strongly Agree

No.	Statement	Rating Scale			
		4	3	2	1
1	Always present in the group when practicing Basic Physics				
2	Always ask for opinions with the aim of getting good grades in Basic Physics practicum				
3	Implementing group decisions regarding Basic Physics practicum				
4	Complete Basic Physics practicum assignments together with the group				
5	Walking around to other groups when working on assigned tasks				
6	Giving support and appreciation to group mates during presentations				
7	My group successfully completed the task on time				
8	My group failed to complete the assigned task				
9	My group was able to proceed as directed together while discussing basic physics lab problems.				

Appendix 2. Collaboration skills assessment sheet before being entered into Google Form

SCIENCE PROCESS SKILLS ASSESSMENT INSTRUMENT LATTICE (SPS)

Science Process Skill Indicators	SPS Sub-Indicators	Item Number	Total
Observation	a. Observing with the senses b. Gather relevant facts c. Look for similarities and differences	1, 2, 3, 4, 5	5
Classification	Identify characteristics and classify objects based on their characteristics	6, 7, 8, 9	4
Measuring	Read scales according to units with appropriate accuracy and use a measurement approach	10, 11, 12, 13	4
Using time/space relationships	Describes the condition of the object/variable to be observed	14, 15, 16	3
Using numbers	Analyze the data obtained from each experiment	17, 18, 19	3
Inference	a. Using learned concepts in new situations b. Using concepts in new experiences to run through what is going on	20, 21, 22	3
Communication	a. Organize and submit reports systematically and clearly b. Explaining the results of an experiment or observation c. Discussing the result of the experiment d. Read graphs, tables, or diagrams	23, 24, 25	3
Predict	Based on observations can suggest what might happen	26, 27, 28	3
Identify and control variables	Identify and control each variable (dependent variable, independent variable, and control variable)	29, 30, 31, 32, 33, 34	6
Data interpretation	Use all appropriate information in making inferences and interpreting the experimental data obtained	35, 36, 37	3
Formulate a hypothesis	Develop a hypothesis	38, 39, 40, 41, 42	5
Define operationally	Describe how to measure an experimental variable and define the variable based on how the work is done	43, 44, 45	3

Appendix 3. The display of the specification of science process skills assessment