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Development and validation of integrated science students worksheet based on science process skills

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Abstract. This research was research and development which focuses to develop Student's worksheet based on science process skills. The development model of the research refered to 4-D model by Thiagrajan which was solved only until defining, design, and development stages. This research aims to find out: (1) Students worksheet based on science process skill in respiratory system to junior high school validity, (2) students worksheet based on science process skill in respiratory system to junior high school practicality, and (3) students worksheet based on science process skill in respiratory system effectiveness to improve student's science process skills. The product examination used one-group-pretest-posttest design and was held in 8th grade of SMPN 13 Makassar for second semester of academic year 2017/2018 with the number of subject was 29 students. The results showed that the instruments used fit the valid criteria, based on the student responses and science process skills tests are categorized as effective.

1. Introduction

The quality of international education was measured through PISA and TIMSS results and the member countries were very concerned about their students' ability to work on PISA and TIMSS. Countries with low PISA and TIMSS ratings indicated that students' science process skills in this country were low, including in Indonesia. Therefore, this research needs to be done to see the characteristics of science process skill (SPS) of junior high school students, especially in Indonesia [1]. The low SPSs of students were due to not being trained with problems of high-level thinking skills during learning, such as problem-solving, analysis, and interpretation. Students were not trained in reading observational data in the tabular form or describing observational data obtained from test results [2].

Implementation of the 2013 Curriculum mandates science learning in junior high schools to be carried out in an integrated manner, in this case physics, chemistry and biology content were presented in an integrated manner in a Basic Competency. The nature of science learning is as a process of science learning was expected to be carried out through the stages of the scientific process to test the truth of the findings of experts, concepts, and existing theories to solve problems through the process of thinking. The reality in the field shows that science learning was still carried out with traditional learning models. The traditional methods cannot develop the integrated science process skills [3]. Therefore, for science learning to be carried out according to the curriculum, it is necessary to have a science learning tool designed to integrate science content and based on science process skills that were realized in the form of student worksheets

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Student worksheet important to directs students to conduct a series of learning activities systematically. The benefits of students worksheet is changing learning conditions, from teacher-centered to student-centered, developing process skills, and developing scientific attitudes [4].

Science process skills (SPS) is a key factor in the study of scientific knowledge because scientific knowledge gained from the study at different times, it is reliable or not [5]. SPSs provide students to learn by doing, experiencing and associating science subject with daily life, and facilitate to convey the learning from Science and Technology lesson to the real life [6]. The low SPSs of junior high school students indicates that science learning process in schools has not been able to facilitate the students to develop the SPSs that students actually possess [2].

The science process skills consist of two, 1) a basic science process skills include observing, inferring, measuring, communicating, classifying and predicting; 2) The integrated skills include controlling variables, defining operationally, formulating hypotheses, interpreting data, experimenting, and formulating models [7].

Students worksheet based on SPS trains students to be active from the beginning to the end of learning because students think finding their own physical phenomena around them [8], can lead to interest in the concepts to be learned, improve students' understanding in identifying scientific issues, explaining phenomena scientifically and using scientific evidence in everyday life [9], Students worksheet makes students more focused on finding concepts through their own activities and can develop the process skills of students[10].

The implication of this study was that there was a need to develop and validate the integrated science students worksheet based on science process skills in respiratory system on eight grade junior high school.

2. Method

This research was a Research and Development using the development of instructional design 4 D model [11]. Research stages include define, design, and develop of Integrated Science Students worksheet based on Science Process Skills on Respiratory System Subject. Disseminate was planned to be carried out on large scale testing (experimentation). Once developed, integrated science students worksheet and instructional tools in the form of eight grade of Junior high school, lesson plan and evaluation instruments in the form of a multiple choice test were validated by two experts and then revised. In addition to validated by experts, evaluation instruments were tested on the eighth grade students of SMP 13 Makassar, Indonesia in the even semester of 2017/2018 school year. The amount of students were 29 persons. The testing of product used a one-shout case study design.

The instruments used in this study were (1) Students worksheet validity instruments; (2) Practical instruments in the form of questionnaire responses to educators; and (3) effectiveness instruments consist of questionnaire responses of students and multiple choice SPS tests.

3. Result and Discussion

3.1. Result

3.1.1. Define. The purpose of this stage was to define the requirements of learning with the analysis of the objectives of the material constraints at beginning. This stage includes: First, front-end analysis aimed to establish the basic problems faced in the course. The results of analysis showed that the Respiratory System subject matter was dominated by learning that is still oriented to mastery of concepts and tends to ignore the empowerment of SPS. Second, the results of student analysis indicated that the heterogeneous student academic ability of students with high academic ability, moderate, and low. Third, task analysis includes any task to support students SPS. The learning outcome of this subject included of students SPS and academic achievement. Fourth, material analysis involved the formulation of learning objectives based on basic competences.

Concept analysis the teaching material used in this study was the human respiratory system, with the following basic competencies:

BC 3.9. Analyzing the respiratory system in humans and understanding the disturbances in the respiratory system as well as efforts to maintain the health of the respiratory system

BC 4.9. Presenting work about efforts to maintain the health of the respiratory system

The results of the material analysis obtained four main sub-materials, namely: (1) respiratory tract for biology, (2) respiratory mechanism, (3) breathing air volume, and (4) disorders of the respiratory system.

3.1.2. Design. This stage aimed to produce the design of student strategies and learning tools. At this stage the students worksheet based on SPS was designed. In design of learning tools consists of: (a) design of Students worksheet, (b) selection of basic competence of subject, (c) initial design of worksheet of Respiratory System & lesson plan, (d) preparation of an SPS test to measure students' SPS (e) design of observation sheet, (f) design of SPS rubrics of student' worksheet based SPS. The result of this stage was prototype of students worksheet based on SPS.

3.1.3. Develop

3.1.3.1 Expert Assessment. A learning device can be said to be feasible or not to be used first must go through a validation process. This validation process was carried out by two experts who were competent in their fields. Aspects assessed by experts were aspects of the format, content, language, benefits / uses of LKPD. The results of expert validation after referring to the criteria for determining validity obtained results in the Table 1. The four aspects of student worksheet assessment were included in the valid category.

Tuble1: Result of Students Worksheet Vullduton					
No	Assessment aspect	Content Validity	Category		
1	Format	1	Valid		
2	Content	1	Valid		
3	Language	1	Valid		
4	Benefit/Uses of Students worksheet	1	Valid		

 Table1. Result of Students Worksheet Validation

3.1.3.2 Limited Testing of Integrated Science Students worksheet Based on SPS

 Analysis of the pretest and posttest scores of students SPS which was use of Integrated Science Students worksheet based on science process skills on Respiratory System
 Table 2 Description of SPS Protest and posttest Score

Final Test Amount of		of Student	Interpretation	
Value	pretest	Posttest		
90-100	0	6	Very High	
80-89	0	14	High	
65-79	0	9	Averag	
55-64	0	0	Low	
0-54	29	0	Very Low	

Based on the data in Table 2, students' pretest value showed that 29 students (100%) who were the subject of the study had SPS in the very low category. There were no student who reach the minimum completeness criteria (MCC) value, which is at 75 point. Whereas for the posttest value, it appears that the SPS value has increased. All students were in the high category.

3.2. Analysis of SPS N-Gain

Increasing the value of the science process skills of students who were taught with integrated science students worksheet based on SPS can be seen in Table 3.

Table 3. Description of Percentage of SPS N-gain Score				
Value	Assessment Aspect	Amount	Percentage (%) of students	
g > 0,7	High	20	68,97	
$0,3 \le g \le 0,7$	Medium	9	31,03	
g < 0,3	Low	0	0,00	

Table 3 showed that 68.97% of students have SPS N-gain in the high category and the remaining 31.03% of students have SPS N-gain in the medium category. N-gain analysis has given an indication that there is an increase in science process skills of students.

3.3. Description of Students' SPS Indicators of students

Based on the analysis of indicators that have been carried out, students can answer well the science process skills test that was given because each indicator of science process skills that has been compiled has experienced a significant increase. The results of the analysis can be seen in Table 4.

Table 4.Results Description SPS Test of Pretest, Posttest, and N-gain						
No	Indicator	Question	Pre test	Post test	N-gain	ory
		Number				
1	Observing	1,2,3	3	29	0,9	High
2	Formulating question	4,5,6,7	4	20	0,7	High
3	Compile a hypothesis	8,9,10	3	17	0,7	High
4	Designing experiment	11,12,13	3	16	0,8	High
5	Communicate	14,15,16,17	4	19	0,8	High
6	Make a conclusion	18-20	3	15	0,7	High

In the Table 4 appears the students' science process skill after the provision students' worksheet integrated science based on science process in VIII_E SMP Negeri 13 Makassar.

3.4. The Results of The Educator's Response

Details of the validation analysis results after using the students worksheet integrated science based on SPS can be seen in Table 5.

Table 5. Educator's Response Students Worksheet					
No	Educators Response of Students Worksheet Precentage	Amount of student	Interpretation		
1.	81,00- 100	2	High positive		
2.	61,00 - 80,00	0	Positive		
3.	41,00 - 60,00	0	Positive enough		
4.	21,00-40,00	0	Less positive		
5.	< 20	0	Not positive		

The results of the analysis show that the average response of two science teachers in SMP Negeri 13 Makassar is the 81.00-100 category with very positive interpretations.

3.5. The Result of Students Response

The description of the result of the students' response analysis after using the integrated science Students Worksheet based on SPS can be seen in Table 6. The results of the analysis in Table 6 show that the average response students in SMPN 13 Makassar is the 81.00-100 category with very positive interpretations.

Table 6. Student responses to Students worksheet						
	Students Response of Students	Amount	Interpretation			
No	Worksheet Percentage					
1.	81,00- 100	26	High positive			
2.	61,00 - 80,00	3	Positive			
3.	41,00 - 60,00	0	Positive enough			
4.	21,00-40,00	0	Less positive			
5.	< 20	0	Not positive			

3.6. Discussion

3.6.1 Validation of Integrated Science Students Worksheet Based on SPS. Based on Integrated Science Students Worksheet Based on SPS validation data, the four aspects of assessment, namely format, content, language, and benefits / uses of Integrated Science Students Worksheet aspect are in the valid category. This Students Worksheet assessment criteria refers to the BNSP criteria (2008), that Students Worksheet must meet the material or content, presentation and linguistic criteria. In connection with this, the developed Students Worksheet is able to guide students in discovering the concept of science in science subjects on respiratory system material. Based on the results of the assessment standard used, the integrated science Students Worksheet developed is said to be feasible to be used by students because the process has met the maximum criteria which is valid with a little revision. This is in accordance with what Den Akker and Nieveen [12] stated that Students Worksheet is said to be feasible if it meets the criteria, namely the results of the validator's assessment stating that Students Worksheet is feasible with revision or without revision and development of students worksheet to meet certain criteria or aspects.

3.6.2. Practicality of Integrated Science Students Worksheet Based on SPS. Based on the validation results of the educator response questionnaire, the educator response questionnaire that was made was classified as a valid category so it was suitable to be used as an instrument to collect data regarding the educator's response. In this case, two natural science teachers at SMP Negeri 13 Makassar responded to the Integrated Science Students Worksheet Based on SPS. Based on the educator's response analysis, the average data of both of them is 83% with a very positive interpretation. According to Trianto [13] that if the results of the questionnaire analysis are at level 81-100, the results of the questionnaire showed that the Integrated Science Students Worksheet Based on SPS on the Respiratory System material in 8th grade was said to be practical.

According to Nurfathurrahmah [14] the assessment of a learning device was said to be practical, if it meets 2 criteria, namely: (1) the tools developed can be applied according to the assessment of experts, (2) the tools developed can be implemented in real terms in the field. This is supported by the results of validation for each device on the average in the valid category, and the results of the overall instrument validation (sheet of observation of the learning device implementation) are in the valid and very valid category. The percentage of implementation of learning activities is 90.32%.

3.6.3. Effectiveness of Integrated Science Students Worksheet Based on SPS. Learning to use integrated science Students Worksheet based on SPS was carried out in three meetings with a time

allocation of 3 JP each. In this study, Students Worksheet was said to be effective if it meets 2 criteria of effectiveness, namely: (1) positive response of students, and (2) learners succeed in learning if the completeness of individual learning is at least 75 and classically a minimum of 80% of minimal completeness (MCC = 75). The value of the effectiveness of the Students Worksheet developed by each instrument.

The response given by students to Student Worksheet was 90.13% with very positive interpretations. Three people with a positive rating average and 26 others with a very positive average rating. This means that in general students have received very well the Student Worksheet that has been developed. This was consistent with the existing theory, where students respond positively if the percentage of agreement was $\geq 50\%$ [15] and according to the results of research conducted by Anggraini, et al [16] that students agree that the process skills approach to student worksheet was applied make students very easy to understand the subject which presented by Science Process Skill.

The SPS indicator measured in this study was an indicator of observing / observing, formulating a problem, formulating a hypothesis, designing an experiment, communicating, and drawing conclusions. These six selected indicators are based on the ability of students in accordance with the level of education they are currently undergoing in the 2008 process standards.

Students worksheet was said to be effective if the results of the skills test of this process make students reach more than or equal to 80%. The reality in the field shows that out of 29 students who were the subject of the study, there were 2 students who had not reached the MCC standard of 75. In other words 93.10% of students were able to achieve completeness so that the student's worksheet was effective because it fulfilled complete class (\geq 80%).

In the science process skills test, indicator 1 was observing or observing in the high category because the questions that have been made to represent this indicator only involve information received by the senses, not questions that mark students to be able to explain what they have observed. This is consistent with the theory expressed by Nur [17]. One of the clues to making observations is to make sure that the observations contain statements about information obtained through your senses, not an explanation of what you observe. Meanwhile, the lowest indicator is indicator 6, which draws conclusions. This was because students still have difficulty formulating conclusions or summarizing what he has discovered in an experiment. In addition, students have not been able to properly link between hypotheses and conclusions which are the conclusions of the objectives to show whether the hypothesis that has been formulated previously proved true or not.

4. Conclusion

Integrated Science Students Worksheet based on Science Process Skills has valid base on interpretation of two validators. The usage of Integrated Science Students Worksheet Based on Science Process Skills is practical with 83 score or very high interpretation. The effectiveness of Integrated Science Students Worksheet Based On Science Process Skills is very high based on student response and student who learn with Integrated Science Students Worksheet Based On Science Process Skills has high score category.

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