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Developing of student worksheets with scientific approach on growth and development topic at SMAN 1 berastagi grade XII academic year 2019/2020

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Abstract. This research aims to design and produce Student Worksheets based on scientific approach on Growth and Development topic. The research design used is Research and Development method with 3D model which is define, design and developing stage. The subjects of this research were Material Expert, Learning Expert, Biology Teacher, and Students of grade XII SMAN 1 Berastagi that consist of 6 classes with 216 students as population sample number. Data collection was carried out with instrument in the form of questionnaire, while the data analysis using qualitative and quantitative descriptive analysis. The result showed this product classified into very feasible category with an average score 95,93% by material and learning experts assessment, meanwhile the assessment of biology teacher obtained 95% with very good category as well. The student responses of the small group, limited group, and large group trials obtained very good category with the whole average score 91,66 %. This student worksheets obtains "Very Feasible" criteria and has fulfilled the requirements of eligibility for use as a medium of biology learning process.

1. Introduction

Student worksheet is a set of activities that provide opportunities for students to expand their understanding of the material learned in accordance with the objectives of learning to be achieved. Student worksheet usually contains instructions for students to perform activities. It aims to guide students perform active activities during the learning process.

The study of the observation has been conducted at SMAN 1 Berastagi and there are some problems that can be identified such as 1) The teachers have not fully used the student worksheets in learning process, 2) The lack of relevant teaching materials to guide active students in the learning process, 3) The worksheets used by students does not meet the learning criteria with the scientific approach because it's only contain a summary of material and biological learning questions, 4) Students have not been trained to follow the learning process with scientific approach. The results of observation and interviews conducted indicates the low activity, interest and learning outcomes of students. It caused by several factors such as: (1) Submission Biology material by teachers with discoursing methods tends to make students feel bored, students are given with less concrete The 6th Annual International Seminar on Trends in Science and Science EducationIOP PublishingIOP Conf. Series: Journal of Physics: Conf. Series 1462 (2020) 012016doi:10.1088/1742-6596/1462/1/012016

information and less interesting discussions by theoretical method; (2) Students never get direct experience such as doing experiment in biology laboratory, so students assume that biology is abstract and difficult to understand; (3) Biology teachers state that one of the factors that causes the problems in learning process is the lack of relevant teaching materials as teacher's guide in teaching biology. These things make students not able to solve the problems, express their opinions, formulating the problems, analyze, and draw the conclusions.

Growth and development topic is one of the material taught in grade XII Senior High School. Growth is the process of increasing the size of an organism's body because of the division in body cells that are quantitative, while development is a process towards maturity in quality of living things. The scientific approach (5M) will assist students in discussing growth and development material by supporting, asking, gathering information, managing information, and communicating can be done directly by students based on objects that can be seen with daily adventures.

Material selection it accordance to syllabus in Basic Competencies 3.1 and 4.1 indicators, Growth and Development is a topic that suitable in using scientific approach . where students are expected to be able to analyze the relationship between internal and external factors with the process of growth and development in living things based on experiments' result. This research use Research and Development method with the 4D model, *Define, Design, Development, and Disseminate*, but the researcher limited this research to 3D stage (*Define, Design, Development*).

2. Theoritical review

2.1. Student worksheets

2.1.1. Defenition of student worksheets. Student worksheets are sheets that contain tasks that must be done by students. In accordance with Prastowo's 2015 statement, student worksheets are printed materials in the form of sheets of paper containing material, summaries, and instructions for implementing learning tasks that must be done by students, which refers to basic competencies that must be achieved.

2.1.2. The purpose of student worksheets.

The benefits obtained by using student worksheets include: facilitating the teacher in managing the learning process, for example changing the learning conditions from the atmosphere of "teacher centric" to student centric ", helping teachers direct students to be able to find concepts through their own activities or in work groups , can be used to develop process skills, develop scientific attitudes and arouse student interest in the surrounding environment; make it easier for teachers to monitor the success of students to achieve learning goals.

2.2. Scientific approach

Scientific approach to learning is directly on the facts and the reality that exists around the student learning resulting in actually using observation and analysis in practice. Therefore, when implementing learning with a scientific approach, the teacher must depart from empirical facts, phenomena, concept and theory that can be accounted for. Learning with a scientific approach can have a positive influence on teachers and students, because learning refers to the process of scientific thinking that trains systematic and holistic thinking. Learning is not only visible from the distancewhere the students build the interrelationship of knowledge but in thinking skills so as to provide opportunities for students to explore and describe the broadest subject matte (Wahyono, Ishak, & Rusman, 2017; Marwanto, Seribulan, Isfaeni, 2014; Lestari, Ristanto & Miarsyah, 2019). Scientific research approaches have increased to student'sability to think high level (Rahayu, 2016; Djamahar, et al., 2019)

2.3. 4D Development Model

The models and stages used in this study are models according to Thiagarajan (1974: 6) in Trianto (2014:231), namely the 4D development model which consists of 4 stages, namely; define, design, develop, and disseminate.

• Define

The purpose of this stage is to define and define learning conditions. This stage includes five main steps, namely; 1) front end analysis; 2) analysis of students; 3) task analysis; 4) concept analysis; 5) formulation of learning objectives.

• Design

This stage consists of 3 steps, namely: 1) preparation of a benchmark reference test, is the first step that connects between define and design stages; 2) selection of media that is suitable for the purpose of delivering lesson material; 3) format selection, for example reviewing existing device formats that have been developed in other more advanced countries.

• Develop

The purpose of this stage is to produce a revised learning tool based on input from experts. This stage includes: a) validation of tools by experts followed by revisions; b) simulations, namely activities to operationalize lesson plans; and c) limited trials with students.

• Disseminate

This stage is carried out to promote development products so that they can be accepted by users, both individuals, groups, or systems.

Desseminate can be done in another class with the aim of knowing the effectiveness of using the device in the learning process. Spread can also be carried out through a process of transmission to related educational practitioners in a particular forum.

3. Method

The research will be conducted at SMAN 1 Berastagi in third grade of science program. The subjects of this study were Biology Lectures as validators (Material Expert and Learning expert), biology teachers and third grade students of science program. The object of this research is a Student Worksheet that has been developed and validated by the expert's team. The method used in this study is R&D (Research and Development), with a 4D model. This development model refers to four-stages namely: (1) define; (2) design; (3) develop; and (4) disseminate, but this research is limited only to developing stage.

The defining stage is the stage for defining and defining development requirements. The purpose of the define stage is to collect various information relating to the product to be developed.

The design is to find a more effective and efficient way to develop the initial product design based on the data obtained at the defining stage.

The developing stage is to modify the proto-type instructional material. In the develop stage, feedback is received through experts evaluation and product trial test.

In this study, the instruments that used by researcher was questionnaires. Questionnaire is a technique of indirect data collection (researchers do not directly ask questions with respondents). The method of data collection conducted by researchers is collecting data with closed questionnaires with 4 alternative answers, which are very feasible, feasible, less feasible (inadequate), and not feasible, and responded by giving advice on the columns provided. In this study, the questionnaire will be addressed to material experts, learning experts, teachers and students with the aim of assessing the feasibility of teaching materials for student worksheet to be developed. Meanwhile, the questionnaire for student responses has 2 alternatives answer, which are yes or no.

3.1. Data analysis technique

The data will obtained in this research are quantitative and qualitative data. Quantitative data in the form of answers to the assessment questionnaire from the validator. While qualitative data in the form of responses and suggestions provided by validators, teachers and students about student worksheets with a scientific approach to the material of growth and development that has been developed.

3.1.1. Analysis of data from expert validation questionnaires and biology teacher responses. Data obtained from the answers to the questionnaires given are analyzed by these following steps:

(1) The data obtained in the form of a checklist is summarized in the form of a Likert scale table that has been given a score as shown in table 3.1

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No	Answer	Score
1	Very good	4
2	Good	3
3	Less good	2
4	Not good	1

Table 3.1 The answer criteria for validation instrument items with Likert sca
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(2) Calculate the level of feasibility with this formula :

$$P = \frac{\Sigma}{N} x 100\%$$

Information :

P = Percentage of Categories

- \sum = Number of answers to the selected category
- \overline{N} = Ideal total score
- (3) From the results of calculations using the formula above, the numbers are generated in the form of percent. The classification of the score is then converted into a percentage form, then estimated with qualitative sentences listed in table 3.2

 Table 3.2 Percentage criteria for the emergence of feasibility indicators of student worksheets for questionnaires validators and teacher response questionnaires.

Interval Percentage	Criteria	Qualification
$81\% \le X \le 100\%$	Very good	The student worksheet products are
		ready to be used in the real field for
		learning activities / there is no revision
$61\% \le X \le 80\%$	Good	Student worksheet products can be used
		in the field for learning activities but
		there is a slight revision
$41\% \le X \le 60\%$	Medium	The product of student worksheets can
		be continued by adding something that
		is lacking, doing certain considerations,
		the additions made are not too large.
$21\% \le X \le 40\%$	Less good	Revise student worksheets by carefully
	-	reexamining and looking for product
		weaknesses to improve
$0\% \le X \le 20\%$	Not good	The product failed, revised massively
		and fundamentally about the contents of
		the product

(4) Draw conclusions from data analysis.

3.1.2. Data analysis results of student responses questionnaire. Data on the results of student responses in the form of questionnaires were analyzed by thesefollowing steps:

- (1) Make recapitulation of questionnaire results on student worksheets;
- (2) Calculates the percentage of student answers
- (3) Conduct analysis, each student is asked to answer a statement with a choice of yes or no answers. the answer "yes" is given a score of 1 and the answer "no" is not given a score or 0. The results of this questionnaire were analyzed using the following formula .

$$\mathbf{P} = \frac{f}{N}$$

Information :

P = Category percentage

f = The frequency which percentage is being searched (number of students who give "yes" answers)

N = The number of student

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(4) From the results of calculations using the formula above, the numbers are generated in the form of percent. The classification of scores is then changed to classification in the form of percentages, then interpreted with the qualitatively sentence like what listed in the table 3.2.

4. Results and discussion

Based on the results of material experts assessment, the student worksheet that has been developed by the researcher is stated with an average score 96.42%. If matched with the eligibility criteria table, the achievement score is included in to very feasible criteria.

Table 4.1 Assessment Result by Material Expert						
Rated Aspect		Indicator	Score	Percentage	Information	
Feasibility	of	1. Material compatibility with core	4	100%	Very Good	
Material		competencies				
Presentation		2. Material compatibility with basic competencies	4	100%	Very Good	
		3. Clarity of material presentation	4	100%	Very Good	
		4. Depth of material	3	75%	Good	
		5. Quality of the material described	4	100%	Very Good	
		6. The linkages of exercise questions	4	100%	Very Good	
		to the material				
		7. Student worksheet quality	4	100%	Very Good	
		8. Accuracy in providing examples	4	100%	Very Good	
		9. The concepts truth	4	100%		
		10. The references quality	4	100%	Very Good	
		11. The attractive of illustration	3	75%	Very Good	
		12. The attractive of pictures	4	100%		
		-			Good	
					Very Good	
Language		13. The language used	4	100%	Very Good	
		14.Readibility	4	100%	Very Good	
		Average		96,42%	Very Good	

 Table 4.1 Assessment Result by Material Expert

Based on the assessment results by learning experts, the student worksheets that has been developed by researchers is stated with a percentage of 95.45%. If matched with the eligibility criteria table, the achievement score is included in the very feasible criteria. It can be concluded that the student worksheets that has been developed was stated to be continued to the next stage that is the feasibility test stage by the teacher and students.

Aspect rated	Indicator	Score	Percentage	Informati
				on
Content	1. Pouring ideas	4	100 %	Very
Feasibility	-			Good
	2. The design of Student worksheet	4	100 %	Very
	cover			Good
	3. Content presentation design	3	75 %	Good
	4. Student Worksheets arrangement	4	100 %	Very
	-			Good

 Table 4.2 Assessment Result by Learning Expert

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Learning	5. Encourage and inspire students to	4	100 %	Very
Components	think critically, analytically, and			Good
Based	on precisely in identifying,			
Scientific	understanding and solving			
Approaches	problems and applying learning material			
	6. Encourage and inspire students to	4	100%	Very
	observe			Good
	7. Encourage and inspire students to	4	100%	Very
	asking			Good
	8. Encourage and inspire students to	4	100%	Very
	reason / associate			Good
	9. Encourage and inspire students to	4	100%	Very
	do experiment			Good
	10.Encourage and inspire students to	4	100%	Very
	draw conclusions			Good
	11.Encourage and inspire students to draw communicate	3	75%	Good
	Average		95,45%	Very
	-			Good

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Based on the results of the teacher's response, the student worksheets that has been developed is stated with an average score percentage of 95%. If matched with the feasibility table, the achievement score is included to very feasible criteria.

Rated Aspect	Indicator	Score	Percentage	Informati
Kateu Aspeci	Indicator	Score	I el celttage	on
Student	1. The design of student	4	100 %	Very
worksheet	worksheet display cover			Good
display	2. The design of material	4	100 %	Very
	presented			Good
	3. Student worksheet	4	100 %	Very
	arrangement			Good
Feasibility of	4. Conformity of the subject	4	100 %	Very
Content	matter with core			Good
Presentation	competencies			
	5. Conformity of the subject	4	100 %	Very
	matter with basic competencies			Good
	6. Clarity of material presentation	3	75 %	Good
	7. The linkages of exercise	4	100 %	Very
	questions to the material			Good
	8. Encourage and inspire	4	100 %	Very
	students to think critically,			Good
	analytically, and precisely in			
	identifying, understanding,			
	solving problems and			
	applying learning material			

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	9. Encourage and inspire students to observe	4	100 %	Very Good
	10. Encourage and inspire	4	100%	Very
	student to asking	4	100%	Good Verv
	student to associate	-	10070	Good
	12. Encourage and inspire	4	100%	Very
	student to do experiment			Good
	13. Encourage and inspire	4	100%	Very
	student to draw conclusions			Good
	14. Encourage and inspire	4	100%	Very
	student to communicate			Good
	their findings			
Language	15. The language used	3	100 %	Good
	16. Readibilty	3	100 %	Good
	Average		95 %	Very
				Good

The student worksheet that has been finished revised by experts and biology teacher then distributed to 9 students accompanied by a questionnaire aimed to finding out the student responses. A small group trial is given to 9 students with different abilities, that is high, medium and low ability. Small group test responses included to "very feasible" criteria with an average score percentage of 92%. After the student has finished responding to the product in small group trials, the researcher will rearrange it and make it better based on the inputs from small group trials, afterwards the researcher will continue to limited group trials.

A limited group trial is given to 21 students with different abilities, that is high, medium and low ability. Limited group test responses included to the criteria of "very feasible" with an average score percentage of 88%. After the 21 students have finished testing the student worksheet, the researcher will refine and rearrange it according to the input given by students so that the student worksheet could be better than before, afterwards the researcher will continue to large group trials.

The student worksheet draft that has been improved is then given to 36 students accompanied by questionnaires that aims to determine the students' responses toward the product. This large group trials included to "very good" criteria with an average score percentage of 95%.

Table 4.4 Student Responses							
No	Group Trials	Score	Percentage	Criteria			
1.	Small group trials	8,35	92%	Very Good			
2.	Limited group trials	18,42	88%	Very Good			
3.	Large group trials	34,14	95%	Very Good			
	Average		92%	Very Good			

The result of Sufairoh (2016), shows that learning with scientific approach is a process that is arranged in such ways so that the learners can construct concept, law, or principle actively through scientific stages. The research of Machin (2014), results in a scientific and character building-based RPP (Semiannually Learning Design). The implementation of such an approach has positive effect on cognitive, affective, and psychomotor learning result, as well as has reached the pre-determined classical accomplishment.

5. Conclusion

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From the results of developing of student worksheets with scientific approach at SMAN 1 Berastagi, it could be concluded that this student worksheet has obtained a high score percentage validity or assessment with very feasible criteria. It means that this student worksheet has fulfilled the requirements of eligibility for use as a medium of learning biology.

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