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To cite this article: T Septiani *et al* 2020 *J. Phys.: Conf. Ser.* **1481** 012071

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Preliminary analysis of student worksheets development with multi-representation approach on 21st century physics learning

T Septiani*, Yulikifli and M Havid

Department of Physics, Faculty of Mathematics and Natural Sciences, Universitas Negeri Padang, Jl. Prof Hamka, Padang 25131, Indonesia

*triseptiani1109@gmail.com

Abstract: The practice of learning at schools supposed to be centered on the student, collaborative, contextual, and integrated with student`s lives in the community. Facts that occur in schools, students have not fully the center of the learning process. Physics learning has been associated with real-life but yet can be solving physics problems that vary in daily life. It causes a lack of competence of knowledge, attitudes, and skills of students in learning Physics. Therefore, the student's worksheet that can help students in the learning process is needed. Student Worksheets with a multi-representation Approach can be used to help students on solving vary physics problems in daily life. The purpose of this study was to find out the preliminary analysis in the development of student worksheets with a multi-representation approach in 11th-grade physics subjects in the first semester. The preliminary analysis carried out in this study was the needs of analysis, student characteristics analysis, learning material analysis, and assignment analysis. Instruments used were questionnaire sheets and interview guideline sheets. The research method used is descriptive qualitative research with research samples who are students of SMA N 15 Padang and SMA N 9 Padang. This research has descriptive data as a result.

1. Introduction

Indonesians should experience significant changes to compete with the demands of the 21st century. Everyone must have higher thinking, verbal communication, written communication, creativity, research skills in problem-solving to compete [1]. Comparative, innovative and collaborative abilities need to be mastered to help humans absorb new information and be able to adapt to changing times.

21st century education has four main principles. Learning should be student-centered, collaborative, have context, and be integrated with the lives of students in the community[2]. In this century learning should be centered on students so that the information obtained in the learning process is more maximal. students must be able to work well together in achieving learning goals. Learning should have a context and integrated into the lives of students.

The challenges of 21st century education make the Indonesian government carry out curriculum reform activities. The change in KTSP to the 2013 curriculum is a form of government efforts after developed curriculum research by the educational needs in Indonesia. The 2013 curriculum transforms the teacher center paradigm into a student center so that it can develop students who can compete, collaborate and be creative in answering 21st century education needs.

Physics learning not only has limited concepts such as knowledge, but plays a role in the inquiry process. Physics can be studied both theoretically and practically. In the process of inquiry, Physics learning can use learning tools by the demands of the 2013 curriculum. Learning tools can be in the form of Learning Implementation Plans, syllabus, teaching materials, learning media, and others. All learning tools are used to achieve learning objectives.

The main thing that is desired in the learning process is the achievement of learning objectives. Learning objectives will be achieved if the learning process goes well. learning will be effective if using appropriate learning materials. Teaching materials are all forms of material used to help the teacher/instructor in conducting learning activities[3]. One of the teaching materials that are often used in schools is student worksheets

Student worksheets are teaching materials printed in the form of sheets of paper containing summaries, materials, and instructions for the implementation of learning tasks, both theoretically and practically following the learning objectives[4]. On the other side of the student worksheet is a guide that has a series of assignments with questions that help students in inquiry or problem-solving[5]. Student worksheets serve as a support for the learning process so students can find more meaningful concepts of Physics. The assignments given in the student worksheet can be theoretical and practical under with the learning objectives to be achieved.

The structure of student worksheets must be structured by the basic principles of systematic student worksheet preparation. There are 7 structures for developing student worksheets[3]. First, the identity of the subject which includes education units, classes/semesters, learning materials and sub-materials. Second, instructional instruction aimed at directing student activities. Third, competencies must be achieved in terms of aspects of attitude, knowledge and skills. Fourth, indicators of competency achievement must direct students towards learning goals. Fifth, support information that has material related to the learning process. Sixth, the tasks and problem-solving steps will be done by students with the model used. Seventh, assessment has the achievement of values that will be obtained by students during the learning process.

Good teaching materials and in accordance with a systematic structure can produce a good learning process. However, in the learning process, learning models and approaches are needed so that students can get better results. Learning physics will be more meaningful if students present physics concepts in various forms. One approach that can be used is to use a multi-representation approach. The multi-representation approach will help students develop deeper concepts.

The process of solving physics problems with multi-representations is useful to assist students in understanding the concepts of Physics. One Physics problem can be elaborated with several descriptions. Multi-representation of these concepts can be verbal, sketch, diagram, graph, and mathematical equation. Verbal descriptions are associated with mathematical representations with more intuitive representations of images and physical diagrams[6]. students do physics problem-solving in various forms so they can deepen understanding. This is related to every student who has skills that are more prominent than other abilities. Some students are who are more prominent in their verbal abilities compared to their spatial and quantitative abilities, some are the opposite[7]. A multi-representation approach can be the solution to this problem.

Facts that occur in the teacher's school have not used student worksheets that match the correct student worksheets. The student worksheets that are used are less helpful to students in discovering physics concepts. Therefore, a preliminary study was conducted to illustrate the initial analysis of student development worksheets with a multi-representation approach in the first semester of high school Physics material in class XI.

2. Research Method

This type of research is descriptive qualitative conducted in May and June 2019. The preliminary analysis used is the analysis of needs and analysis of student characteristics. Valid information requires proper research instruments. The research instrument used was a questionnaire sheet and an

interview guide sheet. The research sample is students of class XI SMA N 15 Padang and SMA N 9 Padang.

Descriptive research to describe or explain as in research variables[8]. The data obtained is qualitative. The results of the analysis obtained are expressed in terms of percentages and then interpreted in the form of scientific narratives

3. Results and Discussion

3.1. Result

The development of student worksheets with a multi-representation approach was carried out to overcome the problems encountered in the preliminary study. The results of the analysis were obtained through a needs analysis questionnaire sheet and student characteristics analysis questionnaire sheet. Needs analysis has several sub-indicators, namely performance analysis, graduation standard analysis, and analysis of learning difficulties. Analysis of student characteristics consists of several sub-indicators namely interest, motivation, learning styles, and student competencies.

3.1.1. Result of Need Analysis. Requirement analysis is one of the important stages of preliminary research to develop a product. The quality of education can be seen from the fulfillment of all needs in the learning process. Educational needs can be described through performance analysis, graduation standard analysis, and analysis of student learning difficulties.

3.1.1.1 Results of Performance analysis. Performance analysis is carried out to describe the things that affect the success of the learning process. This analysis is seen from the identification of teachers and complete facilities available in the educational environment. The results of the performance analysis conducted at SMA N 15 and SMA N 9 can be explained in Figure 1.
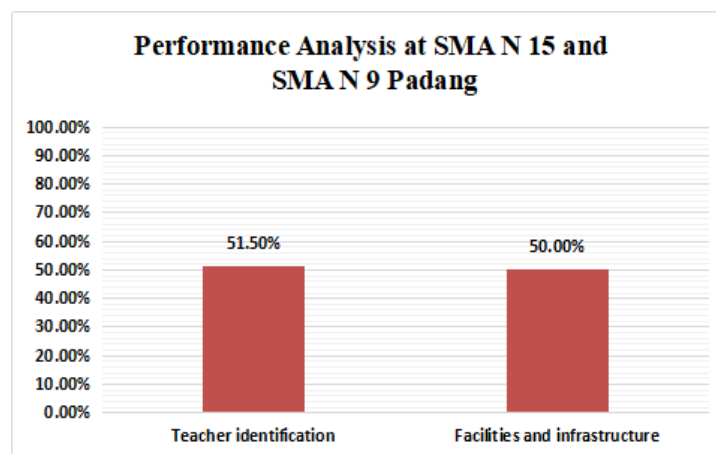

Figure 1. Performance Analysis

Based on Figure 1, it can be explained that the ability of teachers to design the learning process correctly must be improved. This can be seen from the percentage of teacher identification which is only 51.50%. The learning process will run well if the learning tools used are following the provisions of the 2013 curriculum.

From the results of interviews, the facilities and infrastructure available are quite complete, but rarely used according to their functions. Physics laboratories and practical tools are rarely used in the learning process. The teacher does not experiment on each learning topic to develop student's competency skills. This is evidenced by the percentage of the use of facilities and infrastructure in the learning process of only 50%.

3.1.1.2. Results of Graduation Standards Analysis. Analysis of graduation standards can be seen from the competencies that must be achieved by students. Attitudes, knowledge and skills competencies are 3 important competencies students must have per the demands of the 2013 curriculum. Competency attitudes can be explained through the spiritual attitudes, and social attitudes of students. Explanation of the results of the Standard Graduation analysis can be explained in Figure 2.
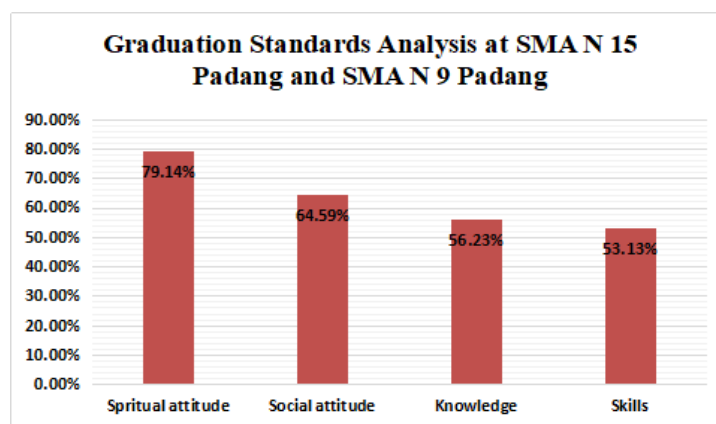

Figure 2. Graduation Standards Analysis

The results of the analysis of graduation standards based on Figure 2 are quite varied. The overall spiritual attitude of students is better than the social attitudes, knowledge, and skills possessed by students. Competencies that have the lowest percentage are skill competencies. Based on figure 2 the competencies of students' attitudes, social and skills need to be improved.

Attitude competency is a very important competency in the learning process. Spiritual attitude competencies in the learning process can be associated with religious values. students have taken action by the religion adhered to but the reality in school students has not been able to link between learning done with religious values. This can be seen from the results of the analysis of students' spiritual attitudes, namely 79.14%. In addition to spiritual attitude, there is good interaction between students and between students and teachers must also be improved. The results of the analysis of social attitudes obtained from the observations were 64.59%.

The results of the competency analysis of knowledge and skills are not good enough. This can be seen from the percentage of knowledge and skills analysis is 56.23% and 53.13%. This percentage is supported by the results of interviews with Physics teachers at Padang 15 High School. Students have not been able to express and discover the dimensions of knowledge themselves correctly. practical implementation in schools is not maximal because of lack of ability to collaborate, the ability to use practice tools well and difficulties in answering hypotheses.

3.1.1.3. Results of Learning Difficulty Analysis. Analysis of learning difficulties is done to decrease the difficulties and failures of students in the learning process. The difficulty of the learning process can be overcome by using learning models, approaches and teaching materials that have been suggested by the 2013 curriculum. One of the teaching materials that can be used is student worksheets. An explanation of the results of the analysis of learning difficulties can be seen in Figure 3.
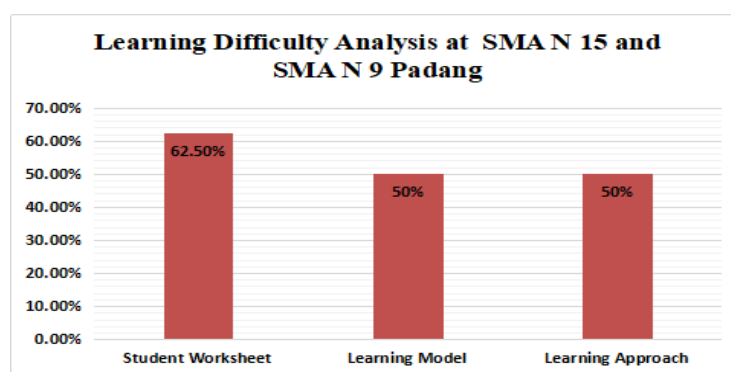
Figure 3. Learning Difficulty Analysis

The results of the analysis of learning difficulties in Figure 3 explain that the use of student worksheets, learning models and learning approaches has not been maximized. The percentage of the results of the analysis of the learning difficulties of student worksheets was 62.50%, the learning model 50% and the learning approach 50%. Therefore, it takes a student worksheet that has a learning model and an appropriate learning approach to help achieve the learning objectives.

3.1.2. Results of Characteristics Analysis of students. . Student analysis can be described from several sub-indicators that have been designed on the student questionnaire sheet. Sub indicators used include students' interest and motivation in learning physics, student learning styles and competencies possessed by students. Student competencies include attitude competencies, knowledge competencies, and skills competencies. Description of the results of the analysis of student characteristics data can be explained through in Figure 4.
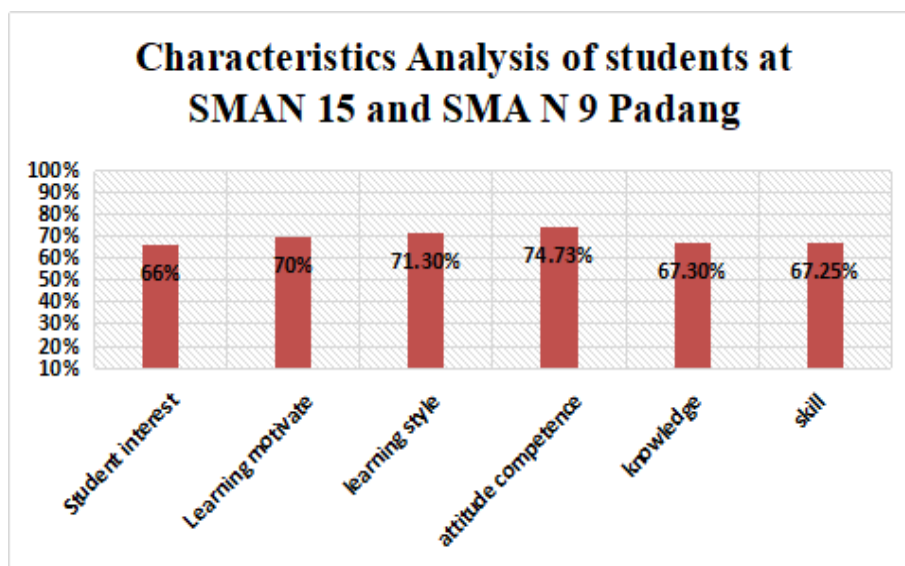

Figure 4. Characteristics Analysis of students

Student characteristics can be explained through 6 sub-indicators. Overall interest, motivation to learn, learning styles, attitudes, knowledge, and skills of students in SMA N 15 and SMA N 9 Padang still need to be improved. Physics learning has not yet attracted students' interest in learning. The teacher is not maximized in bringing up student motivation in learning Physics. Competence of attitudes, knowledge and skills of students can be said to be still standing. This can also be influenced by the teaching style of the teacher who is not by the learning styles of students, learning models and teaching materials used by teachers in learning physics. This is evidenced by the percentage of

students' learning interest by 66%, 70% learning motivation, 71,30% learning style, 74,73% attitude competency, 67,30% knowledge and 67,25% skills.

3.2. Discussion

The success of a learning process is marked by the achievement of learning objectives. Achieving learning objectives requires several aspects, namely teachers, students, learning models, learning strategies, learning media, learning resources, teaching materials and so on[9]. Some aspects that support the Physics learning process must be updated according to the demands of the 21st century. Things that need to be updated such as teacher preparation in teaching, learning models used, learning approaches that are tailored to student needs, and teaching materials that help students understand physics concepts. The teacher's ability to design good learning tools is needed. One of the learning tools is teaching material. The teacher must use teaching materials that are appropriate to the needs of students and can help students carry out learning objectives. In fact, the teacher had difficulty developing student worksheets that were under the 2013 curriculum. This resulted in the achievement of competency skills not being achieved on several Physics topics.

The facilities and infrastructure provided by schools are quite complete but are rarely used in the physics learning process. Laboratories as an infrastructure to support learning activities are not used optimally. Teachers have difficulty in using existing practicum tools. Therefore, teaching materials are needed that can guide teachers to practice well.

Learning outcomes achieved by students in the learning process are called competencies. Competence is something that is owned by students and is a major part that must be formulated in learning, which has an important role in determining the direction of learning[10]. Competencies that must be possessed by students are attitude competencies, knowledge and skills competencies. Every student must have good competence to achieve learning goals. One example is a good social relationship is an external force for students in achieving competence in good social attitudes[11].

Learning physics is considered difficult for students. To minimize student difficulties, appropriate learning models, approaches and teaching materials are needed in Physics learning. Good teaching materials are teaching materials that fit the needs and help students achieve learning goals. One example of teaching material is a student worksheet. The right learning model and approach is also an important part of overcoming learning difficulties. The multi-representation approach will help students to understand the concepts of Physics in depth[6]. Student worksheets with a multi-representation approach are the right solutions to help students make learning goals easier.

Students are an important part of the learning process. Following the opinion of Jenifer Nicol that learning should be student-centered[2]. Analysis of students viewed from aspects of interest, motivation, learning styles, attitudes, knowledge and skills competencies. These six aspects are components that must be owned by students. High interest and motivation can increase student curiosity. Teachers' teaching styles must be adapted to student learning styles. The Inappropriate teacher teaching style will affect the competence of students' attitudes, knowledge, and skills.

The results of the needs analysis and analysis of student characteristics indicate the average percentage categorized as sufficient. The solution to this problem is teaching material that can help students to understand physics concepts in-depth, increase student interest and motivation and improve student competence as a whole. Therefore a preliminary study was conducted as a basis for the authors to develop student worksheets with a multi-representation approach in learning high school physics.

4. Conclusion

Based on preliminary research that has been found, it is known that the implementation of the physics learning process is not following with 21st century education. This is evidenced by the development of teaching materials that are not under the rules and application of models and learning approaches that are less than optimal. Therefore, it is important to develop student worksheets with a multi-representation approach to improve student competence in facing the increasingly rapid development of the times.

Acknowledgments

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