Preliminary analysis of interactive student worksheets development using the science process skill approaching the 21st century physics learning

Rahmi Agustia Widestra, Yulkifli Yulkifli and Elmi Yanto Adhar Samudra

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

*yulkifliamir@gmail.com

Abstract. Science learning in 21st century learning should be students-centered by emphasizing the direct experience of students be able to develop competencies and the ability to think. This requires students ability to be able apply the scientific method in finding knowledge based on the steps of science process skills. However, in reality students still haven’t been able to independently acquire knowledge by applying scientific methods, because learning process still not fully student-centered. Based on that problems, we need students worksheet that able to improve the attitude, knowledge and skills competencies of students. Student worksheets developed using approaches that could make students focus on developing their competence abilities. An introductory study was needed as a basis for designing the development of the students worksheet. The purpose of this study is to describe physics learning, teaching materials used in learning and the characteristics of students, which become preliminary studies to design the development of interactive student worksheets using the approach of science process skills. This research is a descriptive study, with sample are physics teachers and grade X students of two high schools in Padang. The instruments used consisted of student questionnaire, student needs analysis sheets and interview guide.

1. Introduction

The 21st century is a century that has undergone very fundamental changes, in which the era of globalization took place which requires Human Resources (HR) that are capable to keep up with the development of science and technology. In the 21st century, it is expected that HR will be able to compete globally, namely in terms of high skills, critical thinking, logical, systematic and competent to cooperate well and mastering technology. HR must be improved through innovation in learning tailored to the demands of 21st century learning both in formal and informal learning.

21st century learning includes four important aspects, namely student-centered, collaborative, fulfilling the context and integrated with the community[1]. Student-centered learning requires students to be able to explore their own knowledge through the process they experience themselves especially in science learning,
this requires students to be able to have science process skills. This science skill is the ability of students to apply scientific methods in understanding, developing and discovering science[2] as well as making students more active, increasing the responsibility of students, and helping them to understand practical studies, increasing a sense of responsibility for their own learning[3]. So 21st century learning requires students to be more active in acquiring their own knowledge by using scientific methods and becoming the center of learning.

The government has made several efforts to achieve educational goals and 21st century education challenges. Some of the efforts made by the government to improve the quality of education include revision or development of the curriculum. The final revision in the form of the 2013 curriculum that is used right now. Other efforts are to improve the quality of teachers, where teachers must be professional, have expertise, responsibility, and sense of well-being supported by strong professional ethics. Therefore a teacher must have adequate competency qualifications to be able to guide students to find knowledge based on their experience in the learning process takes place[4]. The government's latest effort is to provide complete books to schools to meet the needs of the teaching materials used at school.

Physics learn about nature and the phenomena through a series of scientific processes. This series of scientific processes consists of observing natural phenomena, formulating hypotheses, conducting experiments to answer hypotheses, and evaluating all findings. This shows that learning Physics cannot be separated from the process skills approach. Process skills in science learning are better known as science process skills

The purpose of physics learning will be more easily achieved if supported by learning tools such as RPP, syllabus and teaching materials. Teaching material itself is an arrangement of materials derived from learning sources and arranged systematically[5]. A teaching material will be more interesting if it is presented interactively, meaning that there is a reciprocal relationship between teaching materials and students that will facilitate students in understanding learning. One example of teaching material is the Student Worksheet. Student Worksheets are guidelines for students who are used to carry out investigation or problem solving activities[6]. Student Worksheets are teaching materials that are systematically designed and it is expected that students can find concepts independently through the learning process. Student Worksheets will be meaningful if students are easy to use and can improve achievement of competency[7].

Forming of Student Worksheets must be in accordance with the basic principles of systematic forming of Student Worksheets. The constituent components of the Student Worksheet are seven, namely identity, learning instructions, competencies, indicators of competency achievement, supporting information, tasks and problem solving steps, and assessment[8]. The preparation of systematic teaching materials will produce good learning. Good learning will be more optimally achieved if the teaching materials used contain models, strategies or approaches that are able to focus the abilities of students in the learning process. Physics learning that requires students' independent abilities in finding knowledge with the scientific method, should use an approach in the form of a science process skills approach. This science process skill will guide students to understand physics learning systematically and independently.

Observations have been made on two schools in the city of Padang to find out whether learning has been carried out according to the demands of 21st century education. Results of teacher interviews and distributing student questionnaires for each school concluded that 1) learning is centered on students but not yet implemented completely because the teacher is still the center of information in learning, 2) the ability
of learners to find information based on experimental results and their own experience is still not carried out optimally because there are still some components of students' science process skills that have not been achieved during the learning process, and also students are rather difficult in applying the scientific method in finding a knowledge, 3) teaching materials used are student handbooks that are still in the form of printing, and still not utilize interactive technology in their use and 4) Students Worksheets that used in school do not yet contain interactive technology and science process process approaches in it.

In this paper, research is carried out by analyzing students and interviewing teachers. The aim is to describe physics learning in schools, teaching materials, and the characteristics of students. All data obtained is the initial data used to design the development of Interactive Student Worksheets using the Science Process Skill Approach. as a solution to the problems found in the learning process at school

2. Research Method

Type of this research is descriptive research with a qualitative approach conducted in May-June 2019. Descriptive research is not intended to test certain hypotheses [9] but describes, interprets and explains or explains as in a variable or condition [10]. The data obtained from this study are descriptive data. Samples were taken from two schools in the city of Padang, namely SMAN 9 Padang and SMAN 4 Padang

The instruments used in data collection are in the form of interview guideline sheets, needs analysis sheets and student characteristics sheets. The interview guideline sheet is filled out based on the results of interviews from the physics teacher from each school. The needs analysis sheet is filled in by the observer through the observation of teaching teachers in the class. The student characteristics sheet is filled by 20 students per school.

The needs and characteristics of students data is analyzed based on the scores given for each question. The number of scores from the observation sheet is then averaged. Determination of the title of competency level is as follows:

| No. | Category    | Value       |
|-----|-------------|-------------|
| 1   | Very good   | 90 < N ≤ 100|
| 2   | Good        | 75 < N ≤ 90 |
| 3   | Less        | 60 < N ≤ 75 |
| 4   | Very less   | ≤60         |

3. Results and Discussion

3.1 Result
The results of this study are the percentage of the average score of the needs analysis and analysis of the characteristics of students. Need analysis includes three components, namely: performance analysis, graduation standard analysis, analysis of learning difficulties. Analysis of the characteristics of learners includes the components of the ability and willingness of learners to learn, namely: motivation, interest in learning, learning styles, attitudes, knowledge, and skills during the learning process.
3.1.1 Results of Need Analysis. Need analysis is one of the important initial investigative steps to be taken in carrying out a development. Needs analysis needs to be done to gather information about gaps in the learning process and then look for priorities or appropriate ways for these gaps [12]. The results of the needs analysis can be translated into three components, namely performance analysis, analysis of graduation standards and analysis of learning difficulties.

3.1.1.1 Results of Performance Analysis. Performance analysis is carried out so that an overview of the performance that students should have after the learning process has been obtained. This performance analysis is reviewed from two aspects, namely the identification of teachers and the completeness of infrastructure in schools. The results of the performance analysis conducted at Padang 9 High School and Padang 4 High School can be explained in Figure 1.

![Graph of Performance Analysis Results of Padang 9 High School and Padang 4 High School](image)

Figure 1. Graph of Performance Analysis Results of Padang 9 High School and Padang 4 High School

It can be explained from Figure 1, that for indicators of teacher identification are still in the less category, it can be seen from the percentage of 59.38%. In other words, the teacher's ability to design and present the correct learning process in accordance with the demands of the 2013 curriculum still needs to be fixed. The learning process will going well if the teacher acts as a facilitator and full learning of the student center, and the learning tools used in the learning process are not interactive and are not in accordance with the basic competencies designed by the 2013 curriculum.

The facilities and infrastructure owned by the school both the physics laboratory and the computer laboratory are complete, but the utilization of these two laboratories in the process of learning physics is still not optimal yet. Teachers rarely use laboratories and laboratory equipment in the learning process, because they are hit by time and must explain the learning material that is left behind. The use of computer laboratories has also not been implemented in the learning process because learning devices have not used interactive principles. This can be seen from the percentage of infrastructure facilities that are still low at 54.17%.
3.1.1.2 Results of Analysis of Graduation Standards. The standardized graduation analysis is conducted to see the competencies possessed by students. The 2013 curriculum emphasizes that there are three competencies that must be possessed by students, namely attitudes, knowledge and skills competencies. Attitude competencies were observed in the form of spiritual attitudes and social attitudes. The results of the graduation standard analysis can be explained through Figure 2.

![Analysis of Graduation Standards](image)

**Figure 2.** Results of Analysis of Graduation Standards of Padang 9 High School and Padang 4 High School

Overall from Figure 2, attitudes have a higher percentage than social attitudes, knowledge and ability of students but still in the less category. Knowledge and skills competencies have a lower percentage than other competencies. This shows that the attitude competencies, knowledge and skills of students must be increased again, especially on the skills of students in applying scientific methods in finding knowledge in the learning process.

The spiritual competence of students has reached 75.00% is in good category but ability to associate learning with religious values in the learning process is still not optimal. Social attitude competencies that should be better between students and students and students with teachers still need to be improved better. The competency percentage of social attitudes is 64.58% which is in the less category. This is due to the fact that there are still some students who only want to work when one group is with close friends and there are also some students who are afraid to ask when the learning process takes place because they are afraid of being scolded or laughed at by their friends.

The results of the competency analysis of knowledge and skills are in the very less category of 58.93% and 58.75%. Students are still not able to independently discover and express their knowledge by using the scientific method appropriately. Practicum implementation in schools is still not done optimally because of the low science process skills possessed by students, and students are rather difficult in following the practical steps in practicum instructions.

3.1.1.3 Results of Learning Difficulty Analysis

Analysis of learning difficulties is done to see the location of the difficulties experienced by students in the learning process, so that solutions can be sought to minimize to overcome these difficulties. Learning
difficulties can be overcome by using learning approaches and teaching materials recommended by the 2013 curriculum. One of the teaching materials that can be used is the Student Worksheet. The results of the analysis of learning difficulties can be explained through Figure 3.

![Analysis of Learning Difficulties](image)

**Figure 3. Results of Analysis of Learning Difficulties of Padang 9 High School and Padang 4 High School**

Can be explained from Figure 3, that the use of teaching materials in the form of Student Worksheets, learning models and learning approaches has not been implemented optimally. That shows on the percentage of the results of the analysis of learning difficulties in the LKPD indicator, learning model, and learning approaches, respectively 55.88%, 60.00% and 67.86%. The three indicators are still in the less category which should be further improved. Student Worksheets used in the learning process and practicum still make it difficult for students to find solutions to problem solving in learning Physics. Therefore a Student Worksheet is needed by using the right learning approach to achieve the learning objectives. Lack of application of worksheets, learning models and learning approaches causes the lack of students' skills in constructing their knowledge, because it is not equipped with a strong foundation of learning models and appropriate methods of learning approaches.

### 3.1.2 Results of Characteristics Analysis of Students

Results Analysis of student characteristics can be explained in Figure 4.
Based on the results of the analysis of the characteristics of students in Figure 4, it can be explained that there are six indicators observed. It can be seen that overall indicators of interest is 67.14%, learning motivation is 70.50%, learning style is 69.38%, attitude is 73.75%, knowledge is 65.05% and skills 67.73%. All the category still need to be improved because they are still in the less category. Students still think physics is difficult so the interest of students to study physics is still low. The teacher is still not optimal in presenting fun physics learning to arouse the interest of students in learning physics. Competence of students’ attitudes can be seen higher than knowledge competencies and attitude competencies, but all three are still in the less category. The low competency of students can be caused by teacher teaching styles that are still not adjusted to the learning styles of students in the classroom and the lack of teaching materials that attract the attention of students to be able to enjoy physics lessons, and learning approaches that are less applied in the learning process and in materials teaching used. Students will be more motivated if the teaching materials used by the teacher can be used easily and there is feedback felt by students, or in other words interactive teaching materials.

3.2 Discussion

Improvement of the learning system carried out by the government in the form of 2013 curriculum development aims to achieve optimal learning goals. Learning objectives are detailed formulations of competencies that must be possessed by students after passing the learning process [13]. Achieving the competencies of these students requires several supporting aspects, namely the teacher's teaching style, learning style, learning model, learning approach, teaching materials, technology and so on [14]. In order to achieve the learning process according to the demands of the 21st century, it is necessary to make improvements to the supporting aspects that are felt to be lacking and have not been able to optimally meet the demands of 21st century learning.

The use of teaching materials in class is still not able to make students active, and have the motivation to take part in learning. Teachers should provide teaching materials that can meet the needs of students and learning goals and are fun to be used by students. However, the teaching materials used still cannot attract students to learn because no feedback is obtained from the Student Worksheet used. Learning will be more
fun if the teacher is able to develop an interactive Student Worksheet, but the teacher is still willing to develop a Student Worksheet accordance the 2013 curriculum, moreover having to use interactive principles in the Student Worksheet. This has not yet achieved optimal Basic Competence 4 in the learning process due to the teaching materials used still not supporting 21st century learning.

Facilities and infrastructure in schools are classified as complete, starting from physics laboratories to computer laboratories. The laboratory is still not used optimally in the physics learning process, thus causing the teacher's limited ability to use and demonstrate laboratory equipment to students. Therefore it is very important for teachers to be able to design Student Worksheets in which there are instructions for using tools, work methods and so on so that later students will find out for themselves how to find solutions to the problems they will encounter using the scientific method.

From the analysis results it was found that the competence of students was still in the less category. Competence itself is the ability of each individual to work which includes aspects of knowledge, skills and work attitudes that are in accordance with established standards[15]. These three competencies must be owned by students well in order to achieve learning objectives.

This lack of competency in attitude, knowledge and skills is caused by the many assumptions of students that physics lessons are difficult. To reduce the difficulties experienced by students, it is necessary to approach learning and teaching materials that are appropriate for learning physics. Teaching materials that are well used in learning are teaching materials that accordance 2013 curriculum, one of which is the Student Worksheet. Learning will be interesting if the teacher's teaching style in the classroom can increase the motivation of students and the teaching materials used are interactive teaching materials so that direct feedback from the teaching material is seen and further increases the motivation and interest of students and the learning process becomes more interesting. Learning approach is one of the things that can improve the quality of learning. The science process skills approach will enhance the ability of students to apply scientific methods in understanding and developing science. This is in line with physics learning which is a series of scientific activities in the learning process.

Achieving good learning outcomes when students are comfortable, and interested in participating in the learning process. There are six important aspects which if owned by each student will achieve good learning outcomes. These six aspects are interest, learning motivation, learning style, attitude competence, knowledge and skills. Teacher's teaching style greatly influences the learning style of students. If the teacher's teaching style is fun and is adapted to the learning style of the students and is supported by teaching materials that attract the attention of students, there will be interest and motivation for students to take part in this lesson become a driver to improve the competency of students' attitudes, knowledge and skills.

The results of the needs analysis and analysis of the characteristics of students still show the percentage of those with less categories. The solution to these problems is teaching materials that can improve the ability of the scientific method of students to understand physics concepts, increase students' interest and motivation and improve competency attitudes, knowledge and skills of students. Therefore a preliminary study is the basis for the authors to develop an Interactive Student Participant Worksheet using the approach to science process skills in high school physics learning.
4. Conclusion
Preliminary analysis result that conducted on teachers and students at SMAN 9 Padang and SMAN 4 Padang, it can be concluded that Physics learning process not done according to the demands of the 21st century and has not been integrated with interactive technology yet. This is evidenced by the results of the needs analysis and analysis of the characteristics of students who are still relatively low and fall into the unfavorable category. Therefore, it is necessary to develop an Interactive Student Worksheet using the science process skills approach to the study of Physics.

5. Suggestion
This paper have some deficiency, that test schools are only in two schools, it should be done more than two schools so that the data obtained is more accurate. For researchers after this, the initial analysis is only on the ability of students should be seen also in other aspects to be more developed.

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