

Stem Approach Students' Worksheet Development with 4D Model in Sound Waves Topic

Richard Wynn Aristo*, Togi Tampubolon*

*(Faculty of Mathematics and Natural Sciences, State University of Medan, North Sumatra, Indonesia)

Abstract:

This study aims to make student's worksheet on Sound Waves material in accordance to the STEM approach, to find out how much the students responses to the developed student's worksheet and find out how feasible the student's worksheet are developed. This study uses the 4D development model and it is limited to the third stage, namely the development stage. This research was conducted in SMA Negeri 1 Perbaungan and the data obtained in the form of questionnaires. From the results of the material expert's assessment, the student's worksheet developed received a percentage of 96.43% and 95% by education expert. Then the results of the assessment by the physics teacher got an average percentage of 95.54%. The percentage results of individual response is 78.75%, the percentage results of small group response is 88.75% and the percentage results of large group response is 95.56%. So it can be concluded that the student's worksheet which was developed in accordance to the STEM approach obtained a good assessment and appropriate to be used as a source of physics learning.

Keywords —Student's Worksheet, 4D Model, STEM Approach.

I. INTRODUCTION

Education is the most powerful weapon we can use to change the world and for self-enlightenment. This is so because quality education equips one with capability to interpret things rightly and applying the gathered information in real life scenarios (Thangeda, 2016). The need in educating pupils to produce high quality generation with the capability to deal with 21st century globalization has become a very important agenda nowadays. 21st century learning focuses on four skills (4Cs) that should be mastered by pupils, namely communication, critical thinking, collaboration and creativity (Rusdin, 2018). According to Ghavifekr (2015), in this 21st century, the term "technology" is an important issue in many fields including education. This is because technology has become the knowledge transfer highway in most countries. Technology integration nowadays has gone through

innovations and transformed our societies that has totally changed the way people think, work and live. Therefore, during the learning needs student worksheet that can improve skills in the face of 21st century globalization which is modified with existing technology.

Worksheets are found useful and practical materials for conceptual understanding if they were effectively used in learning environments. Worksheets are materials by which students are given transaction steps regarding what they are supposed to learn. Also, they include activities which give the students main responsibility in their own learning. Thus worksheets are known to help students gain scientific process skills such as setting up experimental mechanism, recording data, interpreting the data, and so on so that they can conceptualize the concepts in their minds (Yildirim, 2011). Astutik(2017) states that collaborative worksheet allows students to develop the ability

affective and psychomotor ability. Student worksheets can be collaborated with various scientific approaches, so it can improve the students' ability during the learning process.

Permendikbud No. 65 Tahun 2013 about Standar Proses Pendidikan Dasar dan Menengah has decided that the importance of the learning process by using scientific approaches. In line with this, Zaim(2017) states that the scientific approach is a learning strategy using scientific steps in each learning material. The scientific approach has a characteristic that is "doing science" which requires teachers to improve the learning process with activities that are as detailed as possible which can function as instructions during the learning process takes place. According to Motlan (2016) and Simatupang (2015) scientific approach can improve student learning outcomes.

STEM is an abbreviation of the initials of the words Science, Technology, Engineering and Mathematics. This technology-based education, termed STEM in the United States, is understood to be an integral part of math and science courses at school level, but it is also understood to be teaching engineering and technology with in-class and out-of-class activities. All the disciplines that make up the STEM play an important role in the development of twenty-first century skills such as adaptability, communication, social skills, problem solving, creativity, self-control and scientific thinking (Sarac, 2018). Besides that, Chien(2016) states that STEM learning approach helps to improve the higher order thinking skills of the students.

II. METHOD

The research method used in this study is Research and Development (R & D) with a 4D development model (Trianto, 2010). The research and development of students' worksheet with STEM approach is carried out until third step, namely: 1) define, 2) design, and 3) develop. The research subjects are physics lecturers as material and education experts, physics teachers in SMA Negeri 1 Perbaungan and students in class XI MIA

SMA Negeri 1 Perbaungan. Where, this study will use 4 students for individual testing, 16 students for small group testing and 36 students for large group testing. Data collection techniques used are interview, observation, direct and indirect communication techniques. Data collection tools used are validation sheets and questionnaires sheets

III. RESULTS AND DISCUSSION

A. Results of Research

These results describe about the STEM approach students' worksheet development in sound waves topic using the 4D instructional development model that limited until the third stage; develop. The students' worksheet assess by experts and physics teachers, the purpose of the assessment is to see how is the quality of the students' worksheet. These experts and physics teachers were provided some comments, suggestions, and assessment of the products. The comments, suggestions and assessment from experts and physics teacher were taken as the basis for revising the students' worksheet so it could become a better product. The Table 1 below will show the data of the results by experts and physics teacher.

TABLE 1
ASSESSMENT RESULT BY EXPERTS AND PHYSICS TEACHERS

Assessor	Total Score	Percentage	Category
Material Expert	54	96.43%	Very Feasible
Education Expert	38	95%	Very Feasible
Physics Teachers	53.5	95.54%	Very Feasible

Based on the data in Table 1 above, the students' worksheet was scored with percentage of 96.43% which includes to very feasible category by material expert. Then, by education expert was scored with percentage of 95% which includes to very feasible category. Following by physics teachers that was scored with average percentage is 95.54% which includes to very feasible category.

After the experts and physics teachers scored the students' worksheet, it continues to the next step that is testing to the students. The Table 2 below

will show the data of the results of students' questionnaires.

TABLE 2
QUESTIONNAIRES RESULTS BY STUDENTS RESPONSES

Type of Test	Average Score	Percentage	Category
Individual Testing	7.875	78.75%	Good
Small Group Testing	8.875	88.75%	Good
Large Group Testing	9.556	95.56%	Good

Based on the data in Table 2 above, the students' worksheet was given to the students and continued with giving the students questionnaires to score the students' worksheet. In individual testing, they were scored with average percentage is 78.75% which includes good category. Then small group testing, they were scored with average percentage is 88.75% which includes good category. Following with large group testing that scored with average percentage is 95.56% which includes good category.

B. Discussion

The Students' Worksheet that was developed uses steps from 4D model that are limited until the third step, develop. The developed students' worksheet is compiled based on the requirements of good students' worksheet preparation, principles and procedures, based on concepts and theories that apply in the field of physics. Thus the contents of the students' worksheet material can be accounted for scientifically, true in terms of science. The theory and concept of the material and activities in the students' worksheet are obtained from existing books. The various information presented in the students' worksheet is research obtained from various journals and websites. The feasibility of the students' worksheet is theoretically assessed based on the average aspects that have been determined, namely the feasibility of content, the feasibility of presentation, the component of STEM learning, the feasibility of language. This aspect is a description of the requirements of a good students' worksheets according to Trianto (2010).

The students' worksheet was scored by material expert with a percentage of 96.43% in a category of very feasible. The connection of questions with the

material also gets a very good assessment, which is in accordance with the material that refers to the learning objectives. In addition to referring to learning objectives, activities that exist within the students' worksheet must also motivate students in learning independently because the students' worksheet basically functions in carrying out teaching and learning activities and has applied the method of making students active. From education expert, the students' worksheet was scored with percentage of 95% which included into very feasible criteria. The feasibility of presenting content is seen from pouring ideas. The ideas are included in the criteria very well because they are presented from the easy to the difficult ones. The things presented in this students' worksheet can also motivate students to provide learning activities in accordance with the components of the STEM approach. The questions contained in the students' worksheet are made as attractive as possible with the components based on STEM approach components. Following by assessment from physics teachers, it obtained average percentage 95.54% which is included to the very feasible category.

Then, it continues with students' questionnaires assessment about how good is the students' worksheet according to the questionnaires sheets provided. These are three types of testing, namely: individual testing, small group testing, and large group testing. Individual testing were responded by 4 students, one from each class. The percentage results of the assessment was obtained 78.75% which included to the good category. Continue by small group testing, it was responded by 16 students, four from each class. The percentage results of the assessment was obtained 88.75% which included to the good category. Finally, large group testing, it means that the responses were conducted in one whole class, XI MIA-2 SMA Negeri 1 Perbaungan. The total number of the students that gave response is 36 students. The average percentage obtained is 95.56% which included to the good category.

IV. CONCLUSIONS

Based on the results and discussion, it can be concluded that the students' worksheet which is made get good responses from the students and the students' worksheet is included to the meet expectation category. It means that the students' worksheet can be used in learning process with notes, the students' worksheet needs some revisions in accordance to the students' needs.

REFERENCES

- Astutik, S. Susantini, E. Madladzim&Nur, M. (2017). Effectiveness of Collaborative Students Worksheet to Improve Student's Affective Scientific Collaborative and Science Process Skills (SPS). *International Journal of Education and Research*, **5(1)**:151-164.
- Chien, P. L. K. &Lajium, D. A. D. (2016). The Effectiveness of Science, Technology, Engineering and Mathematics (STEM) Learning Approach among Secondary School Students. 95-104.
- Ghavifekr, S. &Rosdy, W.A.W. (2015). Teaching and learning with technology: Effectiveness of ICT integration in schools. *International Journal of Research in Education and Science (IJRES)*, **1(2)**: 175-191.
- Motlan, Sinulingga, K. &Siagian, H. (2016). Inquiry and Blended Learning Based Learning Material Development For Improving Student Achievement On General Physics I of Mathematics and Natural Science of State University of Medan. *Journal of Education and Practice*, **7(28)**:171-176.
- Permendikbud nomor 65. (2013). *Standar Proses Pendidikan Dasar dan Menengah*. Jakarta: Menteri Pendidikan dan Kebudayaan Indonesia.
- Rusdin, N. M. (2018). Teachers' Readiness in Implementing 21st Century Learning. *International Journal of Academic Research in Business and Social Sciences*, **8(4)**:1293-1306.
- Sarac, H. (2018). The Effect of Science, Technology, Engineering and Mathematics-Stem Educational Practices on Students' Learning Outcomes: A Meta-Analysis Study. *TOJET: The Turkish Online Journal of Educational Technology*, **17(2)**:125-142.
- Simatupang, S. Tampubolon, T. &Simanjuntak, M. P. (2015). The Improvement of Students' Learning Outcome with The Implementation of Problem-Based Experiment Model of Electrical Circuits on Subject of Direct Current. 240-248.
- Thangeda, A. Baratiseng, B. &Mompoti, T. (2016). Education for Sustainability: Quality Education Is A Necessity in Modern Day. How Far do the Educational Institutions Facilitate Quality Education?. *Journal of Education and Practice*, **7(2)**:9-17.
- Trianto. (2010). *Mendesain Model Pembelajaran Inovatif-Progresif*. Surabaya: Kencana Prenada Media Group.
- Yildirim, N. Kurt, S. &Ayas, A. (2011). The Effect of The Worksheets on Students' Achievement in Chemical Equilibrium. *Journal of TURKISH SCIENCE EDUCATION*, **8(3)**:44-58.
- Zaim, M. (2017). Implementing Scientific Approach to Teach English at Senior High School in Indonesia. *Canadian Center of Science and Education*, **13(2)**:33-40.