



The Importance of E-Worksheet Based on Problem Based Learning Activity to Improving Student's System Thinking Skills: Science Teacher's Perspective

Muizzudin Rifki Alhanif¹, Dewi Lengkana², M. Setiyarini³, Kartini Herlina⁴

^{1,2,3,4} Department of Science Education Master Study Program, University of Lampung, Indonesia

ABSTRACT: This research aims to describe the importance of learning media in the form e-worksheet with a problem-based learning model to improve students' systems thinking skills which focuses on Energy material. The research model used is the 4D development model (Define, Design, Develop, Disseminate). This article reports on the Define stage. Data collection was taken from literature studies and distributing questionnaires via Google Form, then descriptive analysis was carried out. The teacher respondents in this research were 25 science teachers in Lampung Province. The results of the research show that 60% of the problems experienced by teachers in the field are the lack of teaching materials and learning media that are able to stimulate 21st century skills. As many as 78.3% of teachers have not trained systems thinking skills which are part of 21st century skills. Literacy study results shows the importance of learning media with problem-based learning to improve systems thinking skills.

KEYWORDS: Electronic worksheet, Energy material, Problem based learning, System thinking skills.

INTRODUCTION

Education is an important factor for human life. Through education, humans can gain knowledge, skills and improve their attitudes and behavior. Quality education can create quality human resources. In the 21st century, progress in science and technology has increased rapidly in various countries, thus requiring fundamental changes in education. Therefore, various efforts are needed to improve the quality of education by following developments in existing learning technology

The development of learning technology will have an impact on learning activities that become more innovative, effective and efficient. One of the teaching materials that teachers and students need most in the modern learning process is e-worksheet (Electronic Student Worksheet)[1]. E-Worksheet can simplify and narrow down space and time so that learning becomes more effective. Electronic worksheets can also be an interesting tool when students' interest in learning decreases [1]. Reality in the field, the worksheet used by teachers has not utilized worksheets which are integrated with current learning technology [2]. Worksheet in printed form is still not effective and less practical to use. So to optimize it both in terms of appearance and quality of learning, a transformation based on the convergence of information and communications technology (ICT) is needed.

The digital era in the 21st century presents various kinds of challenges in life. System thinking or systems thinking is one of the most important abilities in the 21st century. Systems thinking helps students organize their thoughts in a meaningful way and make connections between seemingly unrelated problems that become interrelated. Through systems thinking skills, students will be able to study the relationships between components in a system, understand interaction patterns in a system, model a system, and even predict and retrospect a system [3]. Systems thinking skills help students organize their thoughts in meaningful ways and make connections between seemingly unrelated problems that are interrelated [4]. The ability to think systems is very necessary because when students have this ability the process of relating one material to another will be easier. Apart from that, systems thinking is the ability to solve problems by looking at other aspects from various overall sources as well as the relationship of concepts with other sciences. One of the learning models in accordance with systems thinking skills is problem-based learning (PBL). To realize learning activities in accordance with PBM steps and also practice systems thinking skills, a guide is needed in the form of student worksheets. In accordance with current developments in learning technology, it is possible for worksheet to be presented in the form of electronic worksheets, making it easier for students to access them. E-worksheet is teaching material designed using digital media, symmetrical, systematic, interesting to achieve learning objectives, and easily accessible using the internet network [5].



Based on the problems that have been described, researchers realize the importance of systems thinking skills combined with problem-based learning activities in supporting the learning process which can make it easier for students to understand concepts. So researchers are interested in finding out how important activity-based integrated science e-worksheet is problem based learning in improving student's systems thinking skills which focuses on Energy material.

METHOD

This research is a type of research and development or Research and Development (R&D), namely a research method used to produce certain products, and test the effectiveness of these products. The research design used in this research is 4D. There are 4 stages consisting of definition Define, Planning, Design, Development Develop, and dissemination Disseminate [6]. The stage that researchers report in this article is the definition stage. The definition stage in this research includes (1) Study of literature related to e-worksheet, systems thinking skills, and learning models Problem Based Learning, (2) observing 25 science teachers and 126 Junior high school/MTs students in Lampung Province. This research was carried out on 27 August–24 September 2022. The observation sampling technique used was random sampling, with the research subjects being 25 teachers and 112 students. The data collection technique is by distributing a needs analysis questionnaire in the form of a Google form which is distributed online to educators and students. This questionnaire is used to collect data in the field regarding the experiences and needs of students. Data from the preliminary study were analyzed descriptively and qualitatively.

RESULTS AND DISCUSSION

A. Study of Literature

Literature study methods is a series of activities relating to library data collection methods, read and take notes, and manage research materials. In this research, the literature study aims to show the importance of student electronic worksheets, problem-based learning models, and students' systems thinking abilities.

Table 1. The need for e-Worksheet as modern teaching materials

Need	Innovation	Reference
Lack of teaching materials online such as e-worksheet. Printed teaching materials do not attract students' interest in learning	Development of e-worksheet using 3D pageflip based <i>Problem based Learning</i>	[7]
Lack of learning resources, teaching materials, and learning media.	e-worksheet development using 3D Pageflip, and Camtasia Studio 8	[8]
Students tend to be passive and need media that can make it easier for students to understand the material.	Model-based electronic worksheet <i>discovery learning</i>	[9]

Based on this data, the problems that occur in schools are the lack of learning resources, teaching materials and learning media [7]. So far, learning in schools still uses conventional teaching materials in the form of printed books, this causes students to lack interest in learning [8]. Printed teaching materials tend to make students passive in learning activities, so they need media that can make it easier for students to understand the material [9].

Table 2. The importance of problem-based learning models

Need	Innovation	Reference
Teachers must change appropriate learning models to improve 21st century skills	Analysis of the application of learning model <i>problem based learning</i> in improving 21st century skills	[10]
Teaching materials related to everyday life are needed to increase students' interest in learning	Development of learning-based modules <i>problem based learning</i>	[11]



Based on this data, the problem that occurs is that so far the learning model seems monotonous and still uses conventional learning models. This results in students being less active in learning activities [10]. Based on this, teachers should change appropriate learning models to improve 21st century skills [11]. Apart from that, developing teaching materials that are appropriate to the learning model is very necessary because this will support the teacher's needs in implementing the model.

Table 3. Analysis of system thinking capability needs

Need	Innovation	Reference
The process of understanding carried out by students will run faster if students are able to relate one concept to another concept	Analysis of students' systems thinking abilities	[4]
Systems thinking skills in education are currently still limited	Efforts to improve systems thinking with the guided inquiry learning model	[13]
Teachers need to train systems thinking skills, and need examples of instruments to measure students' systems thinking abilities	Development of systems thinking assessment instruments	[14]

Based on this data, it can be concluded that systems thinking skills are very necessary, because with these abilities the understanding process carried out by students will run more quickly [13]. The reality in the field is that students' systems thinking abilities are still very limited [14]. Therefore, teachers need to train systems thinking skills, and need examples of instruments to measure students' systems thinking abilities [15].

B. Observation

The results of field observations were obtained from distributing questionnaires via Google Form to 25 science teachers in Lampung province. The results of the needs analysis regarding the importance of problem-based e-worksheet on the topic of energy in improving systems thinking skills are as follows.

Based on the results of the observation questionnaire that has been obtained, it shows that there are several factors that influence teachers' difficulties in learning science, especially on the topic of energy. As many as 92% of teachers said that the influencing factor was limited learning media, and 60% of teachers said there was a lack of learning resources used by students. Current technological developments should also have an impact on technology in learning activities, so that it can reduce the factors that cause learning to not run optimally [1]. This is reinforced by further data analysis which explains that so far learning has been carried out at school using printed reference books, 84% of teacher respondents stated this for the reason that this is easily provided by the school. Therefore, the need to develop innovative teaching materials by following developments in Technology, Information and Communication is very necessary [2].

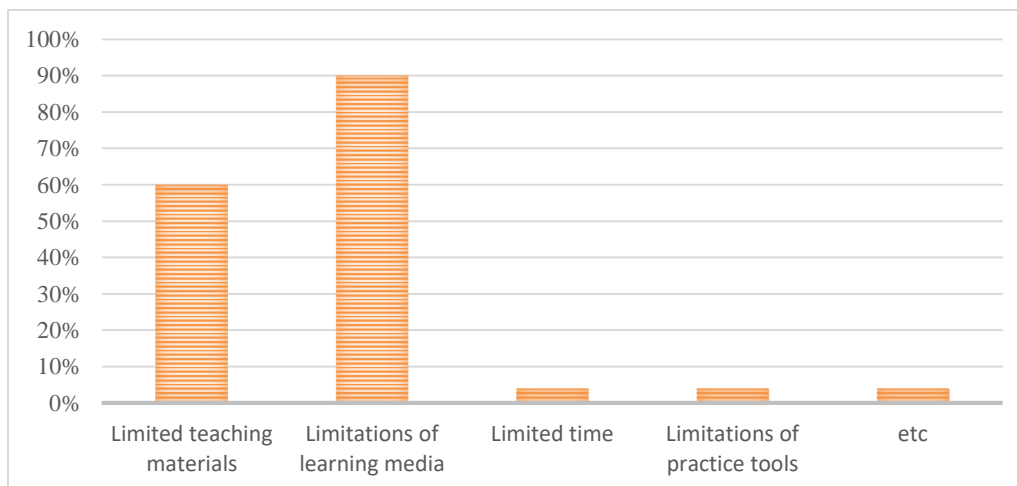


Figure 1. Factors that influence science learning activities are less than optimal

Further data analysis shows that so far the learning models used by teachers in teaching and learning activities are very complex, but only 32% of teachers use problem-based learning models. Even though learning using PBL can familiarize students with solving problems skillfully, it can stimulate students' thinking abilities creatively and comprehensively [16].

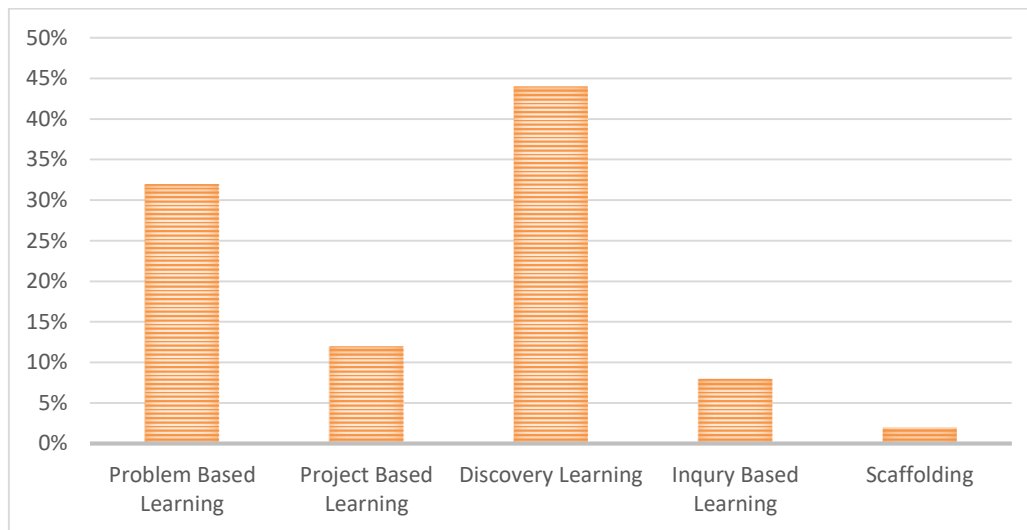


Figure 2. A learning model that is often used by IPA teachers

Based on Figure 2, 32% of teachers apply problem-based learning, but not all of them follow the PBL steps correctly. The teacher only gives assignments and provides problems at the beginning of the lesson, but no follow-up to solve the problem is carried out. In fact, in implementing PBL, several activity steps must be carried out, namely: (1) orienting students to a problem, (2) organizing students to learn, (3) guiding student investigations both individually and in groups, (4) developing and presenting student's work, (5) analyze and evaluate the problem solving process [16]. This data shows that the problem-based learning steps understood and carried out by teachers are not as they should be.

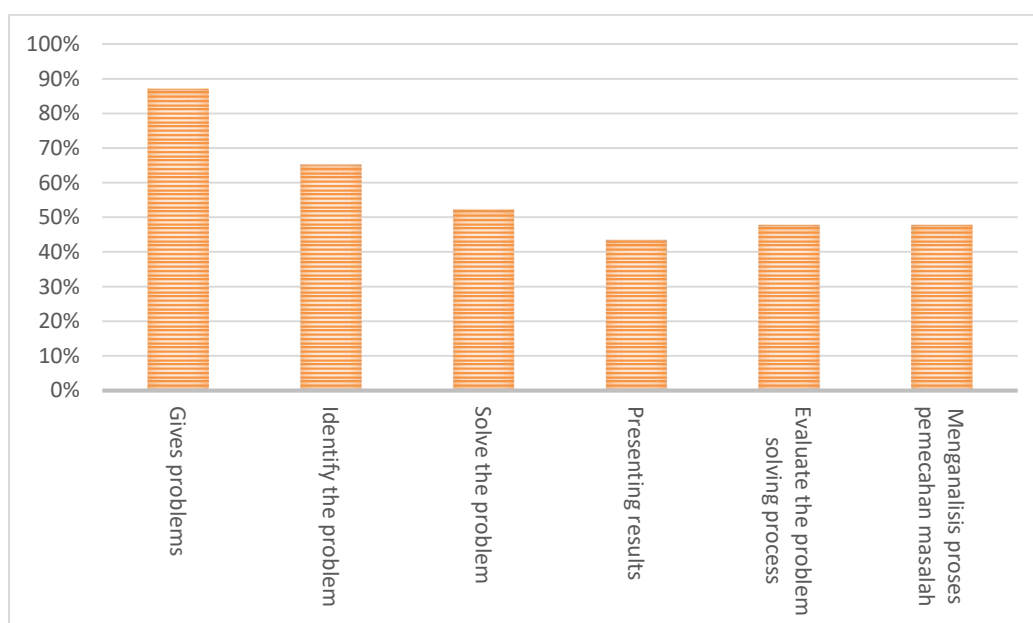


Figure 3. The stages that teachers carry out in PBL model learning



Learning in schools that already use an e-worksheet has not trained students in systems thinking skills. In fact, if systems thinking skills are developed, students will be able to study the relationships between components in a system, understand the interaction patterns of a system, model a system, even predict and retrospect a system[17].

The development of systems thinking skills is described as follows: (1) identifying components and processes of a system, (2) identifying simple relationships between system components, (3) identifying dynamic relationships in a system, (4) identifying system components, processes and their interactions, within a relationship framework, (5) identifying material cycles in a system, (6) recognizing hidden dimensions of a system (i.e., understanding phenomena through patterns and interrelationships that are not easily visible), (7) making generalizations about a system, and (8) provisional thinking (i.e., using retrospection and prediction) [18].

However, the indicators on the worksheet that have been used do not yet show the indicators of systems thinking that they should be. Of the 3 systems thinking indicator instruments that have been tested, all of them have not led to systems thinking skills, namely with the following number of respondents:

Table 4. Indicators of systems thinking that have been applied in learning

Indicator	Answer yet	Answer already
Recognize various interconnected factors related to energy	54,5%	45,5%
Train students to analyze the relationship between energy concepts	78,3%	21,7%
Train students to analyze the impact of relationships between energy concepts	76,2%	23,8%

CONCLUSION

Based on the results and discussion, literature studies related to electronic student worksheets, problem-based learning models, and systems thinking skills are really needed in the modern learning era. This is supported by an analysis of the needs of science teachers' perceptions of electronic student worksheets, problem-based learning, systems thinking skills. The biggest difficulty experienced by teachers in teaching science subjects on energy meters is the lack of teaching materials and learning media. On average, teachers still use conventional teaching materials and learning media. Likewise, the learning model used by teachers has not trained students to have 21st century skills. Based on some data obtained by researchers, it can be concluded that the development of e-worksheet with problem-based learning to improve systems thinking skills is very much needed.

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Cite this Article: Muizzudin Rifki Alhanif, Dewi Lengkana, M. Setiyarini, Kartini Herlina (2024). The Importance of E-Worksheet Based on Problem Based Learning Activity to Improving Student's System Thinking Skills: Science Teacher's Perspective. International Journal of Current Science Research and Review, 7(5), 2578-2583