Students' Perceptions of PBL-STEM E-Worksheets Use on Hydrocarbon Material

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Abstract. The purpose of this study is to determine students' perceptions of PBL-STEM E-worksheets use on hydrocarbon material. this type of research is descriptive quantitative. The study was conducted with 33 students, 17 boys and 16 girls as research subjects in one of the State Senior High Schools in Semarang City. Data were collected using questionnaires and interviews. The data were analyzed using descriptive analysis. The results of this study are (1) 87% of students think that the use of E-worksheet helps them master hydrocarbon material, (2) 88% of students think that E-worksheet is interesting and fun, (3) 89% of students stated that the language used in E-worksheet can be understood well. After using E-worksheet, students felt more trained in solving problems with an average percentage result of 88% and it is included in the excellent category.
Keyword: Perception, E-worksheet, PBL-STEM, Hydrocarbons

INTRODUCTION

The rapid development of information technology in the 21st century has significantly changed the educational landscape (Malik, 2018). Now, technology is an important pillar in efforts to improve the quality of education and prepare the younger generation to face future challenges. Good quality education is the key to creating superior future generations. Therefore, it is important to continue to improve and enhance the quality of education. Some of the main factors that influence the quality of education are the learning approach, curriculum changes, and teacher competence (Fitri, 2021). One effort to improve the quality of education is to improve the learning process in the classroom.

The learning process must involve teachers who can master the learning topic in-depth, especially hydrocarbon material, one of the materials in chemistry subjects that is often considered difficult by students. This material involves abstract concepts and complex chemical formulas. Teachers are required to be able to present three aspects of chemistry in learning so that students can understand hydrocarbon material as a whole (Dewi et al., 2015). They are macroscopic, microscopic, and symbolic. These three aspects are interrelated (Ahmadi & Dewi, 2014). Therefore, innovative learning is needed to help students understand hydrocarbon material better.

PBL-STEM is considered one of the most effective collaborations in science learning, including chemistry (Febrianto, 2021). Problem-based learning (PBL) is a learning model that utilizes problems from everyday life as a basis for the learning process and problem-solving. With this approach, students are required to seek and obtain new knowledge to solve the problems faced (Budiyono et al., 2020), while Anggraini & Huzaifah (2017) explains that STEM is an approach that combines four subjects into one lesson based on the relationship between subjects and real problems. Collaboration between PBL and STEM can help students improve their analytical and problem-solving skills, as well as deepen their understanding of chemical concepts. PBL-STEM allows students to engage directly in projects involving exploration and problem-solving related to hydrocarbons, facilitating more active and collaborative learning. Applying learning models and approaches requires a learning tool that can improve students' abilities. Research conducted by Muthoharoh et al., (2017) stated that worksheets is one of the learning tools proven to increase students' motivation and learning outcomes.

Based on the results of interviews at SMA Negeri 12 Semarang, a school do not have adequate learning media and are still limited, so teachers still use patch-up media. The media used in the school is still in printed form. There has been no development such as worksheets. The lack of interactive media makes students feel unmotivated. It can decrease student learning outcomes. Printed worksheets in learning is less effective (Kholifahtus et al, 2021). In

addition, the use of printed worksheets for students also tends not to face challenges for independent exploration or problem solving that require them to think more deeply.

Worksheets can be optimized by utilizing technology so that worksheets can be designed to be more interactive and combined with learning models that follow student needs to achieve targeted competencies. 21st-century education has begun to adopt paperless technology so that learning devices are presented in electronic format now (Rachmasari et al., 2019). This technology also allows access without the time and place restrictions (Palupi & Patahuddin, 2010). E-worksheet is an innovation for understanding the subject matter at school so that the concept of material and evaluation can be implemented by students more effectively (Augustha et al., 2021).

Learning using E-worksheet can produce different perceptions for each student. This perception is formed from students' views of E-worksheet related to their environment. Perception is a cognitive process in which students receive, organize, and translate stimuli. Therefore, they can understand, realize, and gain experience from their environment, such as in the E-worksheet application. Knowing students' perceptions of E-worksheet application is very important to understand their ability to apply and carry out learning following the contents of E-worksheet, which includes activities such as observing, asking, recording, collecting data, and communicating (Wulandari, 2016).

Based on the description above, it can be concluded that the purpose of using this E-worksheet is to determine the perceptions of SMAN 12 Semarang students regarding the application of PBL-STEM-based E-worksheet on hydrocarbon material.

RESEARCH METHODS

This study is a quantitative descriptive study whose purpose is to determine students' perceptions after using PBL-STEM-based E-worksheet on hydrocarbon material. The research sample consisted of 33 students of class XI-F.6 SMA Negeri 12 Semarang. The sampling technique used is purposive sampling, namely selecting samples based on certain considerations.

The data collection technique used a questionnaire with an instrument in the form of a questionnaire. Data collection methods in this study include interviews and questionnaires. Interviews were conducted with students and chemistry subject teachers. Meanwhile, the questionnaire was filled out by students after learning using PBL-STEM-based E-worksheet. The main instrument used was a questionnaire that aimed to determine students' perceptions of the implementation of E-worksheet.

From the given questionnaire, students also provided suggestions and input related to PBL-STEM-based E-worksheet implementation and the overall learning process. These suggestions and input will be used as revision material to perfect PBL-STEM E-worksheet and to improve the quality of teaching in the future. The data obtained from the questionnaire were analyzed using a percentage formula, and the assessment criteria were determined based on the modified student response assessment guidelines from Sugianto (2018).

Data were collected through a questionnaire consisting of 15 statements that can be divided into three parts, namely: statements related to the use of E-worksheet on hydrocarbon material with six statements, statements about the presentation of E-worksheet to be interesting and fun with six statements, and statements stating that the language used in E-worksheet can be understood well with three statements. This questionnaire uses a Likert scale system, a familiar psychometric scale in questionnaire-based research. In this study, the scale used ranges from 1 to 4 with the categories, namely Disagree (1), Less Agree (2), Agree (3), and Strongly Agree (4). The following is a list of statements included in the questionnaire:

A. Statements related to the use of E-worksheet on hydrocarbon material
   1. The delivery of material in this E-worksheet is related to everyday life
   2. The material presented in this content is easy for me to understand
   3. In this E-worksheet, there are several sections for me to find my concept
   4. The presentation of material in the content of this E-worksheet encourages me to discuss with other friends
   5. The content of this E-worksheet encourages me to pay more attention to the condition of the surrounding environment because of the relationship between the material and the environment around me
   6. The content of this E-worksheet contains hydrocarbon material in the environment that I know

B. Statements related to the presentation of E-worksheet to be interesting and fun
    1. The appearance of this E-worksheet is very interesting
    2. The content of E-worksheet makes me excited about learning chemistry
    3. By using this E-worksheet, learning chemistry can be less boring
    4. The content of this E-worksheet supports me in mastering chemistry lessons, especially hydrocarbon material
    5. The presence of motivational words in the content of this E-worksheet affects my attitude and learning
    6. With the illustrations, it can motivate to learn hydrocarbon material

C. Statements related to the language used in E-worksheet can be understood well
    1. The sentences used in the contents of this E-worksheet are clear and easy to understand
    2. The language used in the contents of this E- worksheet is simple and easy to understand
    3. The letters used are simple and consistent

The data obtained from the questionnaire will be analyzed by scoring. Then, the score is calculated for each aspect of the E-worksheet PBL-STEM assessment. The assessment of the E-worksheet PBL-STEM is carried out using a questionnaire sheet given to students and analyzed using a Likert scale. The validity of this questionnaire instrument will be analyzed using the equation (Sudjana, 2014):

$$P = \frac{f}{N} \; x \; 100\%$$

Description:
P   : percentage of scores
f : total scores obtained
N   : maximum score

The calculation results from the results of the student response questionnaire were then categorized based on the percentage that had been modified by Sugianto (2018) which is presented in Table 1 below.

Table 1. Eligibility criteria for student response questionnaires

Interval	Criteria
85% < X ≤ 100%	Excellent
70% < X ≤ 85%	Good
50% < X ≤ 70%	Fairly Good
0% < X ≤ 50%	Poor

(Source of Table: Sugianto *et al*., 2018)

RESULT AND DISCUSSION

Student Perception Based on Questionnaire

The response is a person's reaction to an object (Widoyoko, 2018). This attitude greatly influences how well they learn during the learning process. After the hydrocarbon learning in class using E-worksheet based on PBL-STEM was completed, students were given a response questionnaire consisting of 15 statements. Students were asked to fill out the questionnaire with the choices of strongly agree worth four, agree worth three, disagree worth two, and disagree worth one. The data from the student response questionnaire results were then summarized in Table 2.

Table 2. Recapitulation of student response questionnaire results

Aspects	Number of Statements	Number of Scores per Aspect	Percentage (%)	Criteria

Material	6	690	87,12	Excellent
Interest	6	697	88,00	Excellent
Language	3	351	88,63	Excellent
Average			**87,92**	**Excellent**

Based on Table 2, the recapitulation results on the material aspect obtained a total score of 690 (the number of points obtained on the material aspect) with a percentage of 87.12%, the presentation aspect obtained a total score of 697 (the number of points obtained on the interest aspect) with a percentage of 88.00%, and the language aspect obtained a total score of 351 (the number of points obtained on the language aspect) with a percentage of 88.63%, so it can be concluded that the E-worksheet PBL-STEM used has excellent responses from students. The results of the student response questionnaire analysis in more detail on each question item can be seen in Table 3 below.

Table 3. Results of the student response analysis

Aspects	Statements	D	LA	A	SA	Total
Material	The delivery of material in this E-worksheet is related to everyday life	0	0	42	76	118
	The material presented in this content is easy for me to understand	0	0	42	76	118
	In this E-worksheet, there are several sections for me to find my concept	0	0	51	64	115
	The presentation of material in the content of this E-worksheet encourages me to discuss with other friends	0	0	60	52	112
	The content of this E-worksheet encourages me to pay more attention to the condition of the surrounding environment because of the relationship of the material to the environment around me	0	2	57	52	111
	The content of this E-worksheet contains hydrocarbon material in the environment that I know	0	2	42	72	116
Interest	The appearance of this E-worksheet is very interesting	0	0	39	80	119
	The content of the E-worksheet makes me excited about learning Chemistry	0	0	45	72	117
	By using this E-worksheet, learning chemistry can be less boring	0	0	48	68	116
	The content of this E-worksheet supports me in mastering chemistry lessons, especially hydrocarbon material	0	0	51	64	115
	The presence of motivational words in the content of this E-worksheet affects my attitude and learning	0	0	48	68	116
	With the illustrations, it can motivate us to study hydrocarbon material	0	2	48	64	114
Language	The sentences used in the content of this E-worksheet are clear and easy to understand	0	0	51	64	115
	The language used in the content of this E-worksheet is simple and easy to understand	0	0	36	84	120
	The letters used are simple and consistent	0	2	42	72	116

Based on Table 3, it can be seen the points obtained from the results of the responses of class XI students at SMA Negeri 12 Semarang to the use of PBL-STEM-based E-worksheet on hydrocarbon material. These results show that

in the material aspect, the highest points are in the first and second statements with a total of 118 points out of a maximum of 132 points, or reaching a percentage of 89.39%. This shows that almost all class XI students of SMA Negeri 12 Semarang can understand the material well through the digital-based practice platform because the questions in the PBL-STEM E-worksheet are varied and not boring. In the aspect of interest, the highest point was found in the first statement, namely with a total of 119 points or a percentage of 90.15%. It means that most students are interested in the appearance and design used in the PBL-STEM E-worksheet. Then, in the language aspect, the highest point was found in the second statement, namely with a total of 120 points or aa percentage of 90.90%. It means that the majority of students can understand the language used in the content of the E-worksheet PBL-STEM because the language used in the E-worksheet PBL-STEM is designed to be simple. Meanwhile, the lowest points were obtained in the aspect of the fifth statement material with an achievement of 111 points or a percentage of 84.09%. Although this statement received the lowest points, the achievement of points still exceeded 75%. Based on Table 3 and the results of the previous analysis, it can be concluded that more than 75% of grade XI students of SMA Negeri 12 Semarang gave a positive response to the use of E-worksheet based on PBL-STEM on hydrocarbon material. This is evidenced by the total points in Table 3 which reached 1738 out of 1980 maximum points, or a percentage of 87.77%. In other words, grade XI students of SMA Negeri 12 Semarang have an extraordinary perception of the E-worksheet PBL-STEM used on hydrocarbon material.

Student Perception Based on Interview Results

To validate the results of the responses of grade XI students of SMA Negeri 12 Semarang to the use of PBL-STEM-based E-worksheet on hydrocarbon material obtained through a questionnaire, an oral interview was conducted. This interview aims to review students' views on the learning process after using PBL-STEM E-worksheet.

Oral interviews were conducted randomly with students, focusing on three main topics: material content, design appeal, and language used in E-worksheet. On the topic of whether the use of E-worksheet helps master hydrocarbon material, student responses were almost similar with positive answers. Some of these answers can be seen in the following quotation:

Very helpful, learning with E-worksheet becomes more interesting and interactive. I can immediately see whether my answer is right or wrong, so I know my ability
I understand better, E-worksheet has a video that helps me understand the concept of hydrocarbon material, so it is easier for me to understand the material
Besides the material more interesting, the questions given also help you think further about hydrocarbons in real life
In my opinion, students can study the material at home using the existence of E-worksheet
I understand hydrocarbon material better because I don't just read it in books

Based on the interview quotation above, it can be concluded that grade XI students of SMA Negeri 12 Semarang gave a good response to the hydrocarbon material taught through E-worksheet based on PBL-STEM. Besides positive responses, some students also gave different views on this topic, as reflected in the following interview quotation:

Other videos can be added for better understanding.
There is too much-written material, it would be better to just make a video.
I don't know the pyrolysis process tool, so I'm confused about understanding the material, just give examples that students often encounter.

The above quote shows that despite the many positive answers to learning with E-worksheet PBL-STEM on hydrocarbon material, some students consider that the use of E-worksheet PBL-STEM has not been able to help them improve their understanding of hydrocarbon material.

The second topic is related to the use of E-worksheet based on the liveworksheets website. The interview questions discussed whether the presentation of E-worksheet is interesting and fun. Based on the interview results,

the answers given by students gave positive values by considering E-worksheet to be interesting for them. There are some quotes from the interviews that have been conducted as follows:

I think using liveworksheets is fun and exciting.
The assignments are easy to do, we can see where the mistakes are, and the scores are immediately visible
The platform is good, and I understand how to use it
The liveworksheets page is quite simple to use in the learning process
Fun, simple, easy to access, and no hassle

Based on the interview excerpt above, it can be concluded that students gave a positive response to learning hydrocarbon material using E-worksheet based on PBL-STEM. Besides positive responses, several students had different views on this topic, as seen in the following excerpt:

I feel that the presentation of E-worksheet is not attractive because the color is too simple
The display is not attractive because there is too much text and few infographics that can help understanding

On the third interview topic, Can the language used in E-worksheet be understood well? The answers from students began to vary by providing their perspectives after reading and working on E-worksheet. However, these answers predominantly show positive values as in the following quote:

The language used is easy to understand and clear, making it easier for me to read the material
The material is written using simple language, but does not reduce the information conveyed
The writing flow in the E-worksheet PBL-STEM is coherent and easy to understand so that understanding the material does not go around in circles
Already using standard and good Indonesian language

Besides receiving positive responses, this topic also got several responses after reading and working on the E-worksheet. There are some excerpts from interviews that have been conducted as follows:

Some parts of the sentence are still confusing, such as the terms in hydrocarbons
The reading has long paragraphs, so it takes a while to understand the material
The language used is rarely heard in everyday life

These results are in line with research by Khartaningtyas and Rosdiana (2020) which states that when students give good or positive responses, their learning outcomes are also in the good category. This positive response from students is also due to their enthusiasm for the use of PBL-STEM-based E-worksheet, which can be easily accessed via smartphones. Students can also repeat the material in the PBL-STEM E-worksheet anytime and anywhere. In addition, the PBL-STEM E-worksheet is presented interactively, allowing students to be more active in the learning process. This finding is consistent with research by Midroro et al. (2021), which shows that digital and interactive learning media are more attractive to students because of their new nature, resulting in positive responses.

CONCLUSION

Based on the results of the study and discussion, it can be concluded that students' responses to PBL-STEM-based E-worksheet showed an average value of 88%, which is included in the excellent or positive category. This response involves students' interest in E-worksheet PBL-STEM and the ease of understanding the material when learning chemistry using E-worksheet. The researcher suggests that E-worksheet PBL-STEM can be an alternative teaching material to facilitate the learning process and help students understand chemical concepts, especially hydrocarbon material.

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