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Teacher's Perceptions toward Electronic Student Worksheet Based on Yellow Well Water Purification Project to Improve Students' Critical Thinking Skills

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Abstract: The objective of this research is to investigate the perceptions of science teachers towards e-worksheet based on the yellow well water purification project to improve students' critical thinking skills. The method used in this research is mixed methods with Explanatory Sequential Design. The data was collected through a questionnaire, then analyzed using descriptive analysis. The questionnaires were distributed to 13 science teacher respondents and 176 junior high school students in Susunan Baru sub-district area. The research results show that 69% of teachers have not used project-based electronic worksheet; based on student questionnaire responses, 72% of teachers have given project assignments to solve problems, but these projects are not based on real problems in the environment. The environmental problem that occurs in Susunan Baru sub-district area is the problem of the quality of well water being polluted by contaminants, causing the water to be yellow and smelly. The current worksheet has not completely train students' critical thinking skills because they are not based on real problems. Based on the research results, it can be concluded that e-worksheet based on the yellow well water purification project is needed to improve students' critical thinking skills.

Keywords: Critical thinking skills; e-Worksheet; Project-based learning

Introduction

In the era of the 21st century, people who are able to compete in the job market are people who have high competitive selling points, such as having various abilities and skills so they can survive and continue to develop in their careers. The 21st century is a challenge for the world of education because students are required to be able to develop and compete with others (Selasmawati & Lidyasari, 2023). These 21st century skills are the basic skills that students need to master to develop their careers in the future, such as critical thinking and problem solving, creativity and innovation, collaboration and communication (Anwar et al., 2024; Fadiawati et al., 2022; Redhana, 2019). Therefore, education in this era does not only focus on providing students with knowledge, but also trains students to master various skills, especially critical thinking skills (Mardhiyah et al., 2021; Wulandari et al., 2024). Critical thinking skills are really needed by students to face various challenges in the future (Apriliani et al., 2021; Ayçiçek, 2021; Putri & Rusmini, 2021; Yulanda et al., 2023).

Critical thinking is reasonable reflective thinking that focuses on deciding what to believe or do (Ennis, 2011). This means that critical thinking is a process of thinking logically by connecting new knowledge obtained with previously owned knowledge so that

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individuals can draw conclusions to solve a problem. In addition, according to Ennis, critical thinking allows a thinker to make observations, use information, and remain open to alternative conclusions when making decisions (Chen, 2021). Current learning certainly needs to train students' critical thinking skills so they can have the ability to solve problems that they may face in real life (Napitupulu et al., 2024; Sulhan et al., 2023; Thorndahl & Stentoft, 2020). Facione (2015) believes that someone who is skilled at critical thinking will be able to make decisions to solve a problem. This ability is very valuable later when students enter society.

However, in reality, the learning process implemented in schools only requires students to master knowledge, but does not train students' thinking skills (Wilsa et al., 2017). Learning that emphasizes students only mastering knowledge will not be able to train and develop students' critical thinking skills (Mareti & Hadiyanti, 2021). The teacher's ability to organize learning experiences greatly influences meaningful learning experiences for students. Learning experiences that show the relationship between conceptual elements will make the learning process more effective (Diawati et al., 2020). The learning that teachers should carry out is learning that is able to train students' critical thinking skills, so that learning does not only focus on mastering knowledge. Learning in this century is based on students' ability to use information to solve real problems that occur in everyday life, being able to adapt and innovate in response to new demands and changing circumstances, and expanding the power of technology to create new knowledge (Septikasari & Frasandy, 2018). There is no innovation in learning programs, especially as the materials used by teachers are mostly only downloaded from the internet, so the learning programs currently used are not based on real problems that occur in everyday life (Agustin et al., 2023). Learning like this is not able to train students' critical thinking skills.

Efforts that can be made to train students' critical thinking skills are by implementing a student-centered learning approach, which can train their critical thinking skills so that it can help them in facing the changing challenges of the 21st century (Niswah & Dewi, 2024; Pnevmatikos et al., 2019). Apart from that, the learning approach can also be carried out through problem solving activities. Therefore, students must be given real problems. One learning model that provides real problems is project-based learning (PjBL).

Project-based learning is a learning model that involves students choosing and investigating their own questions based on a real problem in project activities so that in the end students can create real products (Colley, 2008). The application of project-based learning allows students to use the knowledge they have to solve real problems in the form of projects (Bilgin et al., 2015; Diawati et al., 2020). Project-based learning also allows students to not only learn from themselves but also from other group members (Baser et al., 2017; Cort et al., 2021). Studies show that project-based learning can improve higher-order thinking skills, such as critical thinking, creative thinking, and problem solving (Bell, 2010; Colley, 2008; Diawati et al., 2017, 2018; Velez & Power, 2020). Another study showed that the implementation of project-based learning received positive responses from students, and expressed their desire to be able to apply similar learning in their study programs. Students described the dynamics of work and time constraints as a task under pressure, but at the same time, students saw it as an interesting opportunity to interact freely with teachers and acquire new skills (Raycheva et al., 2016).

The Susunan Baru sub-district area and its surroundings have real problems that can be used as concepts in project-based learning. The real problem that occurs in Susunan Baru sub-district and its surroundings is that the well water source is yellow. When the well water in this sub-district is stored in a container for some time, it causes the water to turn yellow and makes the water storage container turn yellow. With this problem raised, students are challenged to solve this problem and practice their critical thinking skills by using the knowledge they have in the form of project activities. Thus, students are challenged to solve problems with various useful solutions.

In its implementation, this project-based learning model provides flexibility for students to carry out learning outside the classroom, so that the application of this project-based learning model requires guidance for its implementation. One example of a guide in learning is worksheet. Student worksheets are printed materials that contain material, summaries and guidelines for implementing learning tasks that must be carried out by students which refer to the Basic Competencies that must be achieved (Kahar et al., 2021). Good worksheet design is needed so that learning objectives can be achieved and encourage students to play a more active role in learning activities. Apart from that, with the rapid development of technology, these worksheet can be packaged in electronic form (e-worksheet) which can be accessed anytime and anywhere by students without having to print them using paper.

E-worksheet is an exercise sheet for students that is done digitally and is carried out systematically and continuously over a certain period of time (Lathifah et al., 2021; Sudirman et al., 2024). The use of e-worksheet in learning has an impact on learning activities that are more interesting, less boring and more interactive, so that it will have a good effect on student learning outcomes and targets (Nianti et al., 2022). Several researchers who have reviewed project-based e-worksheet include: Tarisna et al. (2023) stated that Project Based Learning-based e-worksheet on science learning content in class V elementary schools can be declared valid, practical and effective in improving learning outcomes. Science for elementary school students. Research conducted by Octaviana et al. (2022) states that the e-worksheet developed has been declared very valid, very practical, and quite effective in improving students' collaboration skills in science learning. The same results were also shown by research conducted by Nirmala et al. (2023) which stated that live e-worksheet based on environmental pollution material is very valid for use in learning and can improve creative thinking skills in junior high school students. However, there has been no research that examines e-worksheet based on real problems in the surrounding environment, namely the yellow well water purification project to improve students' critical thinking skills.

This research is important to do considering that critical thinking skills are one of the basic skills in the 21st century that students need to master in order to have the ability to solve problems that they may face in real life, so that they can develop their careers in the future. Critical thinking skills can be trained by presenting a real problem that exists in the environment in science learning, using project-based student e-worksheets. The real problem that occurs in the Susunan Baru Subdistrict and its surroundings is the source of well water used by yellow residents. This real problem can be raised as a topic in project-based learning, which students will be guided to practice their critical thinking skills to solve the problem. The absence of research that examines project-based student e-worksheets that raises the topic of yellow well water purification projects to improve students' critical thinking skills is the reason why this research needs to be done.

This research describes the perceptions of science teachers and students regarding science learning using e-worksheet based on the yellow well water purification project to improve students' critical thinking skills. These findings also provide a glimpse into the complexity of pedagogical work that can provide input for teachers' professional development to develop their preparation of teaching materials.

Method

This research uses mixed research methods adapted from Creswell and the strategy used is explanatory sequential design by combining qualitative and quantitative data collection and analysis (Creswell & Guetterman, 2019). Participants in this research were 13 science teacher respondents and 176 junior high school student respondents for the 2022/2023 school year. This research was carried out on March 30 - April 14 2023 at public and private junior high schools in Susunan Baru subdistrict and its surroundings. First, researchers conducted a literature study by analyzing the results of recent research regarding e-worksheets, PjBL and critical thinking skills. Next, the researchers developed an instrument to analyze the needs of educators in science learning, then the instrument was distributed to 13 science teacher respondents and 176 junior high school student respondents in Susunan Baru Subdistrict in two ways, namely giving questionnaires directly and via Google Form. There are three indicators of questionnaire questions for teacher and student needs as well as interview guidelines, namely: to find out the use of e-worksheets in science learning, project-based learning based on problem solving, and critical thinking skills. Figure 1 is a research design scheme in sequential research stages, starting with quantitative research and continuing with qualitative research which follows sequentially the sequential explanatory design state strategy.

The data analysis techniques used in this research are data collection, data reduction, data presentation and verification. The data collection process began with the researcher visiting the research location, namely Public and Private Middle Schools in Bandar Lampung City and collecting data from the respondents. The data collected is then reduced by directing the data to matters related to the main points of the research. At this stage the researcher carries out a process to determine and eliminate unnecessary data, then summarize and arrange it completely and systematically, so that the research data obtained is accurate. Next, in the final stage, namely presenting the data and drawing conclusions, at this stage the researcher describes the initial part of the data until it is finished so that the researcher gets conclusions and verification (Miles & Huberman, 1992). After the data is explained, it can be proven with interview data. The procedure for conducting interviews includes their answers about the learning process at their school. In addition, interviews were conducted to explore the reasons for using worksheets in class, project learning models in science education, and critical thinking skills.

Quantitative data analysis and qualitative analysis were carried out in an integrated and triangulated manner. This research data was obtained from questionnaires given to teachers and students, which were analyzed by grouping the answers to questions in the questionnaire, giving points to each answer according to the assessment criteria and calculating the overall score for the answers to each question. This research uses the Guttman scale, namely choosing answers according to the content of the question, namely: "YES" and "No" with a rating of "1" and "0". Then calculate the percentage score and interpret it qualitatively. The formula for calculating the percentage score for each item is:

$$\%\text{Jin} = \frac{\Sigma \text{Ji}}{\text{N}} \times 100\% \quad (1)$$

Where, %Jin is the percentage of answer choice i, ΣJi is the number of respondents who answered, and N is the number of respondents (Sudjana, 2005).

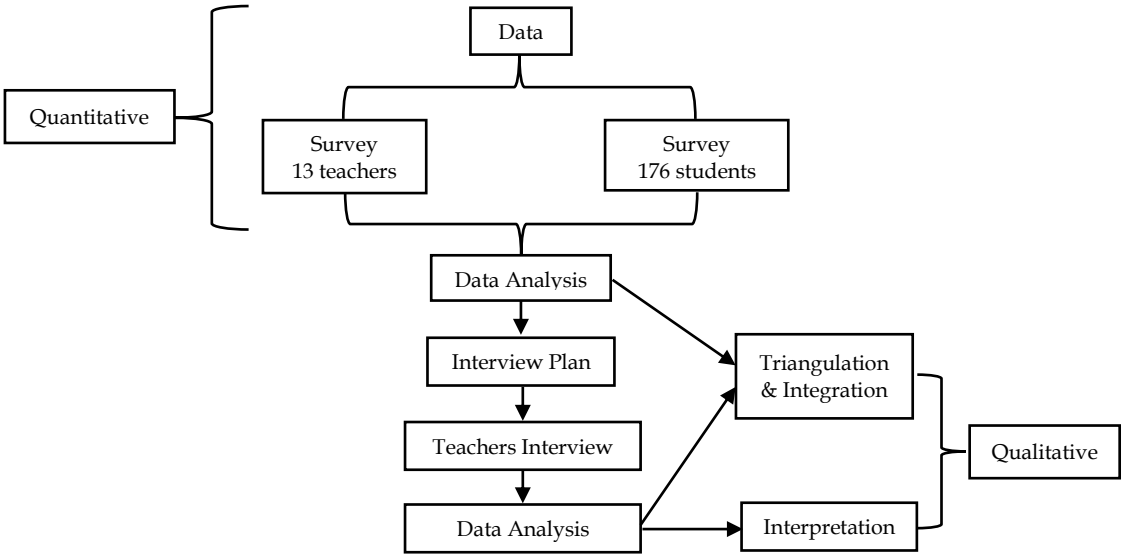

Figure 1. Schematic research design

Result and Discussion

This section outlines the discussion and research findings based on data collection and analysis. The results of distributing questionnaires to 13 science teachers in Bandar Lampung City are presented in table 1.

Table 1. Interpretation results of the teacher perception questionnaire

Question	Percentage (%)	
	Yes	No
Do you know about project-based learning?	100	0
If yes, have you ever implemented project-based learning with students?	77	23
If yes, are the issues raised based on real problems in the surrounding environment?	7	93
Has the problem of yellow well water ever been used in your project-based learning?	0	100
Do you use worksheet in applied project- based learning?	77	23
Have you ever developed a project-based worksheet?	46	54
Have you ever used e-worksheet in your project-based learning?	31	69
Do you know about critical thinking skills?	100	0
Have you ever conducted a test measuring critical thinking skills on students?	46	54
Do you think that the commonly used worksheet helps students to practice critical thinking skills?	62	38
Is there a need for teaching materials in the form of e-worksheet based on yellow wellwater purification to improve students' critical thinking skills?	93	7

Table 1 illustrates that all science teacher respondents know about project-based learning, and as many as 77% of respondents have implemented it in their learning. However, in practice the teachers do not raise topics based on real problems. This is supported by survey results where only 7% of teachers raised topics based on real problems that occur in the surrounding environment in project-based learning. Based on the results of interviews conducted, the teachers only gave project assignments to make predetermined products, such as making biotechnology products and making ecosystem terrariums. The use of a project-based learning model ideally addresses real problems that exist in the surrounding environment, and actually provides freedom for students to determine for themselves what products they will create to solve these real problems (Diawati et al., 2017). Project-based learning focuses learning activities on problem solving which is the main goal of the learning process so that it can provide more meaningful learning for students (Nurfitriyanti, 2016), because in the process students not only understand what they are learning, but also make students know the benefits of this learning for the surrounding environment (Widayanti et al., 2022). In a review conducted by Chen & Yang (2019), implementing project-based learning on students' academic achievement in primary, secondary, and higher education had a more positive impact on students' academic achievement than direct instruction.

The increasingly advanced development of technology and information currently has an influence on the world of education, especially in the increasingly developed use of learning media, one of which is e-worksheet. However, survey results show that as many as 69% of teachers have not used e-worksheet in implementing project-based learning. Based on the results of interviews, information was obtained that the reason teachers have not used e-worksheet in learning is due to the lack of adequate facilities and the rules of several schools which prohibit students from bringing cellphones to school, so this becomes an obstacle for teachers to implement learning effectively. using e-worksheet. In fact, the use of e-worksheet in learning has various advantages. The advantage of using e-worksheet is that it can increase the effectiveness of learning by not limiting space and time (Defista & Aznam, 2024). Moreover, the use of e-worksheet in project-based learning is very important because students often carry out project work outside of class. Apart from that, e-worksheet can be a tool that can attract students' interest in learning (Costadena & Suniasih, 2022; Syafitri & Tressyalina, 2020). E-worksheet can help students understand and study material independently and responsibly (Julian et al., 2020; Sariani & Suarjana, 2022). The use of e-worksheet in learning has an impact on learning activities that are more interesting, less boring, and learning becomes more interactive, so that it will have a good effect on student learning targets (Mawaddah & Siswanto, 2022; Nianti et al., 2022; Solfitri et al., 2023). Therefore, the development of e-worksheet as a learning medium is needed to support a more effective and efficient learning process for both teachers and students.

The survey results show that all teacher respondents know about critical thinking skills, but the indicators of critical thinking skills that teachers understand are different from the indicators of critical thinking skills that should be measured. Based on the results of interviews, the teachers stated that students were said to think critically if they were able to solve problems, provide arguments, analyze ideas based on existing facts, and draw conclusions. The indicators that teachers understand are not as they should be. According to Norris & Ennis in Stiggins (1997), someone is said to think critically if they have carried out the following 5 steps: clarifying issues by asking critical questions; collect important information about the issue; start thinking logically from various points of view; collect clarifying information and conduct further analysis if necessary; and making and communicating decisions.

Norris & Ennis argue that "critical thinking is reasonable and reflective thinking that focuses on making decisions about what to do". According to them, this makes sense because the thinker does not just come to any conclusion, but rather brings the critical thinker to make the best conclusion for the issue based on the available information. This is reflective because the thinker consciously and firmly seeks the best solution. As many as 54% of teacher respondents stated that they had never carried out a test to measure critical thinking skills. Based on the results of the interviews, the teachers were of the opinion that "students' abilities in analyzing problems have not developed optimally, so they still need to be given further practice before they are ready to take the test."

As many as 62% of teacher respondents stated that the commonly used worksheet can help students practice their critical thinking skills. However, based on the results of interviews, the teachers were of the opinion that the worksheet used had not been implemented maximally to train students' critical thinking skills. To train students' critical thinking skills, students must be given problem solving activities based on real problems. The learning model that provides problem solving activities based on real

problems is the project-based learning model. Project-based learning provides opportunities for students to engage in problem-solving activities to produce real products (Diawati et al., 2018). By carrying out project activities, students more easily understand the information they collect, and they can combine all the knowledge they gain from various sources in one project (Aslanidis et al., 2016; Lestari et al., 2024). Implementing project-based learning can facilitate students to develop their critical thinking skills (Colley, 2008; Hikmah et al., 2023; Insani et al., 2018; Juniawan et al., 2023; Sasson et al., 2018). Apart from that, as many as 93% of teacher respondents gave a positive response to the development of teaching materials in the form of e- worksheet based on the yellow well water purification project to improve students' critical thinking skills.

Table 2. Interpretation results of student perception questionnaires

Question	Percentage (%)	
	Yes	No
Has your teacher ever asked you to carry out problem solving activities in learning?	72.00	28.00
If yes, are the issues raised based on real problems occurring in the surrounding environment?	7.00	93.00
Has your teacher ever given or used worksheet as a guide to solving real problems?	100.00	0.00
Was the worksheet you used made by the teacher himself?	97.00	3.00
Have you ever used e-worksheet in learning to solve real problems?	22.00	78.00
Has your teacher ever asked you to solve the problem of yellow well water?	0.00	100.00

The results of filling out questionnaires by 176 junior high school students from several public and private schools in Susunan Baru sub-district area are shown in Table 2. Based on Table 2, as many as 72% of students stated that they had carried out problem solving activities in learning. As many as 93% of student respondents stated that the problem solving activities they carried out in learning were not based on real problems that occurred in the surrounding environment. Based on the results of the interviews, the students answered that the problem solving activities carried out included observing animal and plant cells, practicing styles and their application, and making simple props. The materials used in their problem solving activities do not originate from real problems. This is in line with the response of teachers who have not implemented real problems in the project-based activities they carry out.

As many as 100% of student respondents stated that teachers had provided worksheet as a guide to solving problems. However, as many as 78% of student respondents stated that they had never used e-worksheet in project-based learning. Apart from that, the research results also showed that as many as 100% of student respondents stated that they had never carried out activities to solve the problem of yellow well water. In the fact, this problem can be raised as material for project-based learning, because Susunan Baru sub-district and its surroundings have this problem. Well water is commonly used by residents yellow in color, so if used long term it can cause various diseases. Therefore, the development of project-based e-worksheet which originates from real problems in the form of yellow well water as a learning medium is needed to provide students with experience in solving real problems that occur in the environment around them.

The findings obtained from this research are that the application of the project-based learning model carried out by teachers has not raised topics that originate from real problems, because according to (Diawati et al., 2018) project-based learning that raises real problems allows students to be involved in problem-solving activities , so that students can improve their critical thinking skills. Another finding is that the majority of teachers have not used e-worksheet in implementing project-based learning in their classes. The use of e-worksheet in project-based learning is very important because it guides students to work on project activities which are mostly done outside of class. They also never resolved the problem of yellow well water. Meanwhile, the problem that occurs in Susunan Baru sub-district and its surroundings is that the well water usually used by residents is yellow.

Another perception that was found in this research was that teachers thought that the commonly used worksheet could help students practice critical thinking skills, but had not been implemented optimally. Based on the results of questionnaire data and teacher interviews regarding teaching materials to improve students' critical thinking skills in secondary schools, it is necessary to provide teaching materials that can train students to solve real problems in the surrounding environment, namely e-worksheet based on the yellow well water purification project which can improve students' critical thinking skills.

Conclusion

Based on the results and discussion, the perceptions of science teachers and junior high school students towards students' e-worksheets, project-based learning, and critical thinking skills are not as they should be. The research results show that the perceptions of science teachers and junior high school students regarding e-worksheet, project-based learning, and critical thinking skills are not as they should be. As many as 69% of teachers have not used project-based e-worksheet. They have also never resolved the problem of yellow well water, which occurs in Susunan Baru sub-district and its surroundings. All teacher respondents already know about critical thinking skills, but the indicators of critical thinking skills that are understood by teachers are different from the indicators of critical thinking skills that should be measured. Therefore, it is necessary to provide teaching materials that can train students to solve real problems in the surrounding environment, namely e-worksheet based on the yellow well water purification project to improve students' critical thinking skills.

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Author Contributions

All authors in this article contributed to the process of completing the research. E.P.W. collecting initial research data, processing data, and writing draft of article. C.D. directing research flow, validating data collection instruments, methodology, and reviewing article. N.F. directing research flow, methodology, reviewing article. All authors have read and agreed to the published version of the manuscript.

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No conflict of interest.

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