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Teachers' Perceptions on the Development of Project-Based Learning Program for Vegetable Waste Treatment to Increase Students' Scientific Creativity

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Abstract: Conventional learning that is still applied by teachers causes the quality of human resources in Indonesia to be still relatively low. Teachers should apply learning that can increase the skills needed in 21st century, one of these skills is scientific creativity. In this study to find out the teacher's perspective regarding project-based learning of vegetable waste processing to increase e students' scientific creativity. The research method used is a mixed method with Sequential Explanatory Design. Data collection was carried out by distributing questionnaires to 10 science teacher respondents at junior high schools in Tanggamus. The collected data were analyzed using descriptive analysis. The results of the study show that there are still many teachers who apply the lecture method and 100% of the teacher respondents have never implemented project-based learning and have never solved real problems such as processing vegetable waste in science learning. In fact, the problem that occurs in East Kotaagung District is vegetable waste that is not properly processed. As many as 100% of teacher respondents did not know students' scientific creativity, so they had never been able to increase students' scientific creativity. Based on the teacher's perception of these findings, it can be concluded that it is necessary to develop a learning program based on a vegetable waste processing project to increase students' scientific creativity.

Keywords: PjBL; Scientific creativity; Vagetable waste

Introduction

The 21st century is marked as the century of globalization, which means that human life is experiencing fundamental changes that are different from the order of life in the previous century (Aminullah et al., 2020; Fernandes, 2019; Jayadi et al., 2020). One of the markers is the number of advanced technologies that have been produced to simplify and speed up all human activities (Hermawanto et al., 2020; Jamun, 2018; Putra, 2017). The resulting sophisticated technology is not only based on knowledge but also skills (Chaerudin et al., 2020; Fitri et al., 2020; Rifa Hanifa Mardhiyah et al., 2021). Therefore, to deal with this, qualified human resources with skills that are in accordance with the 21st century skills *framework are needed.*

In the 21st century education framework , various skills are explained that are important to be prepared and must be possessed by today's students, known as 4C (Commucation, Collaboration, Critical Thinking, Creativity) (Muhali, 2019). Through these 4C skills, students are expected to have an attitude of responsibility, self-confidence, social and communication skills, motivation, teamwork, and a good work attitude (Suprapto, 2021). These skills are very important for students as an effort to be able to compete and survive in facing current global challenges. This is the basis for the 2013 Curriculum where students are required to have various 21st century skills in order to achieve success in a century where the world is experiencing very rapid development of science and technology (Sari et al., 2021; Umam et al., 2020). As

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previously explained, the development of sophisticated technologies is very important to improve human life. The 21st century skill that plays an important role in creating this advanced technology is scientific creativity.

Scientific creativity in Indonesia is still relatively low (Zulaichah et al., 2021). This is a challenge for teachers in the 21st century to be able to train students' scientific creativity through 21st century learning. So far, learning is still monotonous because teachers still use the lecture method so that learning becomes less interesting (Prahani et al., 2021). In addition, different educational backgrounds, limited teachers in increasing literature review, and lack of teacher skills in utilizing technology and information for learning resulted in a decrease in students' scientific creativity (Wilsa et al., 2017). The decline in students' scientific creativity is also due to the lack of innovation in learning, learning media are not self-made but downloaded from the internet, and teachers only explain learning material that is not based on real problems in everyday life (Prasetyo et al., 2021). Even though indicators of successful learning in the 21st century are based on students' abilities to use technology and information to solve real problems in life, being able to adapt and innovate in dealing with new demands, creating something that has never existed (Rizqi et al., 2020; Septikasari et al., 2020).

Students are said to have scientific creativity if they have sensitivity to scientific problems and then can overcome them by producing a particular product that is original and has social or personal values, which is designed with a specific purpose in mind using existing information (Hu et al., 2002; Setyadin et al., 2017). In contrast to other creativity, scientific creativity is emphasized on indicators of determining the use of objects for scientific purposes, finding scientific problems, increasing the technical use of a product, scientific imagination, designing creative experiments, solving scientific problems creatively, and designing products creatively (Hu et al., 2002; Prahani et al., 2021) The main characteristics can be interpreted through symptoms that refer to the originality of thought produced, imagination, flexibility, and fluency (Tran, Huang, Hsiao, et al., 2021).

Several studies on scientific creativity have been conducted. Research with STEM learning can increase scientific creativity in elementary and junior high school students (Tran, Huang, & Hung, 2021; Tran, Huang, Hsiao, et al., 2021). In addition, research conducted by Eroglu also states that STEM has a significant effect on increasing the scientific creativity of grade 9 students. STEM learning activities allow students to generate ideas, see events from different angles and create original designs that must be planned (Eroglu et al., 2022). In addition to STEM learning, based on research conducted by Susilawati (2022) and Doyan (2020), inquiry learning can also increase students' scientific creativity (Doyan et al., 2020; Susilawati et al., 2022). Based on these studies, scientific creativity can be trained and enhanced with the right treatment.

Apart from these two learning models, one of the learning models in the 2013 curriculum is predicted to increase students' scientific creativity because it has almost the same characteristics as STEM and Inquity learning, namely Project-Based Learning (Afriana et al., 2016; Kusumawati et al., 2019; Mendikbud, 2016). The characteristics of PBP can increase students' scientific creativity because in learning it involves students in gaining knowledge and skills with a structured process, real experience, and thoroughness to produce original products (Dewi et al., 2019). Through PBP, students apply their knowledge and skills to create alternative substitute products, plan, build, and test these products (Fadiawati et al., 2019). This learning model also involves students in complex problems, problems in the real world, requires students to carry out an investigative process, and requires students to find solutions to the problems they face in a work project. Through project-based learning, students are encouraged to be more active in learning and students' scientific creativity increases (Fadiawati et al., 2021) .

Real problems in everyday life that can be used in project-based learning are vegetable waste from households and markets that are still not being used properly. This vegetable waste can cause bad smells and various diseases, so it needs a solution. This vegetable waste can be recycled into several products that are beneficial to life, one of which can be processed into compost (Gunawan et al., 2015; Larasati et al., 2019).

Based on the above problems, it is estimated that the vegetable waste processing project-based learning program can increase students' scientific creativity. Therefore, this study aims to determine teachers' perceptions of project-based learning of vegetable waste processing in enhancing students' scientific creativity.

Method

The research was conducted at a state junior high school in East Kotaagung District with 10 science teacher respondents taking place on February 1, 2022. The research method used in this study was a mixed method adapted from (Creswell et al., 2017). The strategy used in this study was Sequential Explanatory Design with a scheme that can be seen in Figure 1.

Based on the Sequential Explanatory Design scheme above, the research starts with quantitative research and continues with qualitative research following an explanatory strategy. The instrument used

in this research is by using a questionnaire. The data collection technique was carried out through distributing questionnaires with Google forms which were distributed online through school principals which aimed to find out teacher perceptions of vegetable waste processing project-based learning programs that could improve students' scientific skills. The questionnaire given to the teacher respondents consisted of three indicators of teacher questionnaire statements and interview guidelines, namely learning methods and models used in science learning, project-based learning, and scientific creativity.

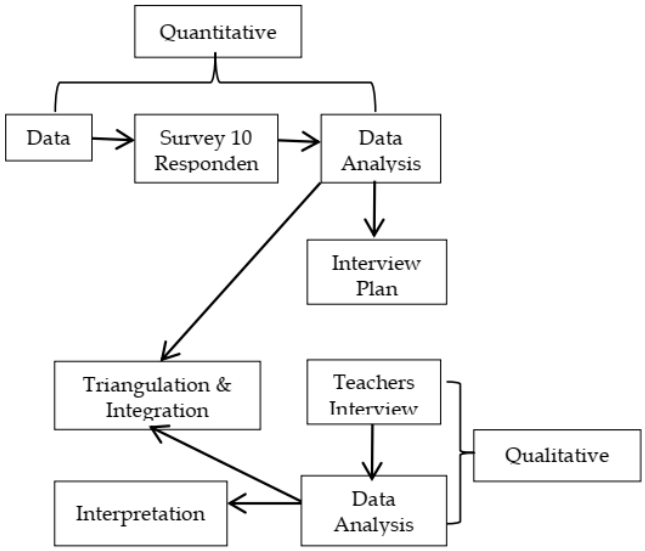

Figure 1. Schematic research design

Data analysis techniques used in this study are data collection, data reduction, data display, and verification. Data collection began with researchers distributing questionnaires to 10 teacher respondents. The next step is data reduction by determining, defining, and eliminating data that is not needed by focusing on important things related to the main points of research. After that, the data display step by means of which the data is summarized and arranged in a complete and systematic manner so that the research data obtained is accurate and can be completed. Then in the final stage, the presentation of data and drawing conclusions is carried out. After the data is described, it is then verified through the completeness of interviews and documentation. Interviews were conducted to find out the learning methods and models used, project-based learning, and scientific creativity. Qualitative and quantitative data analysis was carried out in an integrated and triangulated manner.

The data obtained from the teacher's questionnaire were analyzed by grouping the answers from the teacher respondents based on the questionnaire questions. Then give a score to each answer according to the scoring criteria. Then calculate the total score of the answers to each question. The questionnaire uses the Guttman scale where the answer choices are in accordance with the contents of the question, namely "Yes" with a score of "1" and "No" with a score of "0". Then calculate the percentage score and interpreted qualitatively. The formula used to calculate the percentage score for each item is as question 1 (Sudjana, 2005).

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

Information: % Jin = Percentage of answer-i choices, ∑ Ji = Number of respondents who answered answer-i, N = Number of all respondents.

Result and Discussion

Based on the collection and analysis of data obtained from research that has been carried out by distributing questionnaires to 10 science teachers at public junior high schools in Kotaagung Timur District, which is shown in table 1.

Based on table 1 it can be seen that 100% of teacher respondents have never used the project-based learning model in science learning. Even though all teacher respondents had not yet implemented the PBP model, as many as 70% of teacher respondents already knew about the PBP model and knew project-based learning syntax. As many as 30% of teachers responded that they had produced products in science learning.

As much as 100% of teachers responded that they had never raised a problem in learning science. However, all teacher respondents responded positively that in science learning it is necessary to use real problems in everyday life as well as global problems so that the learning that students get can be useful and meaningful in students' lives. All teacher respondents also did not use Student Worksheets (LKS) in science learning activities. All respondents also responded that they had never prepared project-based worksheets such as processing vegetable waste.

All teacher respondents apparently did not know about students' scientific creativity and its indicators. This also affected the teacher's response that they had never prepared project-based worksheets such as processing vegetable waste to train students' scientific creativity. As many as 100% of teacher respondents responded positively that it is necessary to develop project-based learning programs to increase students' scientific creativity.

The following is data from interviews conducted with 4 natural science teacher informants from the same school. This interview was conducted to find out the teacher's perception of the methods and models used in

science learning, knowledge of project-based learning models, and students' scientific creativity.

Table 1. Results of Interpretation of Teacher's Perception Questionnaire

Question	Percentage (%)	
	Yes	No
Have you ever used the project-based learning model?	0	100
Do you know about the project-based learning model?	70	30
Do you know the stages of project-based learning?	70	30
Have you ever used learning problems?	0	100
In your opinion, is it necessary to use real problems in everyday life and global problems?	100	0
Have you ever done learning that produces a product?	30	70
Do you use Student Worksheets in science learning activities?	0	100
Have you ever prepared project-based worksheets, such as treating waste in your life?	0	100
Do you already know about students' scientific creativity?	0	100
Have the project-based worksheets that you made/used been able to train students to increase scientific creativity?	0	100
In your opinion, does scientific creativity need to be trained in students in teaching science?	100	0
In your opinion, is it necessary to develop a project-based learning program to increase students' scientific creativity?	100	0

Teacher's Perception Regarding the Learning Method and Model used

Based on data collection through questionnaires, it shows that the teacher respondents have never used project-based learning in science learning. In this interview, the methods and models used by the teacher will be explored further.

Teacher resource 1 stated: "In science learning I choose the lecture method in learning, because this method is easy to implement and practical. If it is not explained, students will look confused and do not understand, so I prefer to use the lecture method. However, after I explained to the students, I would give practice questions in the printed book. I have never used any learning model in science learning because in my opinion learning will take a long time by applying the syntax of the learning model. I never use the problem of processing vegetable waste in science lessons, I just explain the essence of the material I teach. I also never use worksheets, either from publishers because they are expensive or I make them myself because I don't have time to make them".

Teacher resource 2 stated: "I use lecture and discussion learning methods. In my opinion, if science learning only relies on teacher explanations, it will result in students becoming passive and their ability to solve problems in the questions given is low. For example, when I give questions that are not the same as the examples I gave, students will look confused and cannot work on the questions. So I use the lecture and discussion method so that students further improve their ability to solve the problems given. I have used the inquiry learning model and discovery learning model because the two learning models have syntax that is easy to apply. I have never used the problem of processing vegetable waste in science lessons and I have never used worksheets during discussions, both with the learning model and when not using the learning model, I only provided practice questions that I made myself for them to discuss. I don't have time to make my own LKS, especially if it's based on a learning model. Besides that, buying LKS from publishers is too expensive".

Teacher resource 3 stated: "The learning method that I use in learning science is the lecture method because in my opinion the lecture method is more effective, efficient and practical. I have a lot of students in one class, if using discussion or experiment or demonstration methods, learning is not conducive and controlled, students often play games in their groups. I have never used any learning model in science learning because using a learning model will make the delivery of the material longer so that in one semester not all of the material can be delivered. I have never used the problem of processing vegetable waste in learning to speed up the delivery time of subject matter. I also never used LKS in science learning. Inadequate facilities and infrastructure to make their own LKS, whereas buying from a publisher is too expensive for my students".

Teacher resource 4 stated: "I use the learning method, namely the lecture and discussion and experiment methods because it makes the classroom atmosphere livelier, students become more active, students become able to learn through direct experience, accustoms students to listening to other people's opinions even if they differ from theirs, social attitudes such as tolerance, democratic, critical, systematic thinking, patient and so on to increase. I've used the discovery learning learning model because in my opinion, discovery learning syntax is easy to implement and efficient in terms of time. I've used worksheets for students to experiment with but they don't contain the syntax of the learning model. I have never used the problem of processing vegetable waste in learning."

Based on the results of these interviews, the findings obtained are that many teachers still use the lecture method. As a result, students become bored

during learning and often they do not pay attention to the explanations from their teachers and feel sleepy when learning science. This is in accordance with research conducted by (Meidawati, 2019; Nesi, M., & Akobiarek, 2018) that learning using the lecture method is less fun for students. This is because the teacher's way of teaching still uses one-way communication where the teacher acts as a giver of knowledge while students are considered passive recipients of knowledge so that learning takes place in a monotonous manner.

The learning model that is often used is discovery learning for the same reason, namely because discovery learning syntax is easy to apply and efficient in terms of time. However, it turns out that there are still teachers who do not use any learning model even though they use the 2013 curriculum for reasons of time efficiency, because applying the learning model takes longer. In addition, even though there were teacher informants who used the lecture method combined with discussion and used learning models, it turned out that the teacher informants had never used worksheets, whether they were self-made or from a publisher. Even though LKS can be made by yourself and can be much more interesting and contextual according to the situation and conditions of the school or the socio-cultural environment of students (Tarigan et al., 2019). What the students discussed were the questions given by the teacher.

Teachers' Perceptions of Project-Based Learning

Based on collecting data from the questionnaire on teacher responses, a positive response was received that many teachers already know about project-based learning. This interview will explore further the teacher's perception of project-based learning.

Teacher resource 1 stated: "Based on my knowledge, project-based learning is a learning model where students have to complete a project given by the teacher. But I forgot about project based learning syntax. I never use project-based learning because it takes a lot of time and I don't have time to prepare projects for my students to work on. I also never produce products in science learning".

Teacher 2 informant stated: "In my opinion, the project-based learning model is a student-centered learning model to conduct an in-depth investigation of a topic. The project-based learning syntax is 1) setting the project theme, 2) setting the learning context, 3) planning activities, 4) processing activities, 5) implementing activities to complete the project. I have never implemented this learning model because of inadequate school facilities and infrastructure. But I have produced products in learning, namely sticky tape and cassava on biotechnology material".

Teacher resource person 3 stated: "According to what I know about the project-based learning model, it is a learning model that uses projects to solve problems given by the teacher by producing products. Project-based learning syntax, namely 1) fundamental questions, 2) designing product plans, 3) preparing schedules, 4) monitoring project progress, 5) testing results, 6) evaluating experiences. I have never implemented the project learning model because it takes quite a long time and the facilities and infrastructure at school are inadequate. I have produced products in learning, namely cassava tape, katan tape, and tempeh ".

Teacher resource person 4 stated: "The project-based learning model is a learning model that uses projects to solve problems given by the teacher by producing products. The project-based learning syntax is the orientation phase, identifying and determining projects, planning projects, implementing projects, documenting and reporting projects, and evaluating and implementing projects. I have never implemented the project learning model because it takes a long time and the tools are inadequate. I have produced products in learning, namely salted eggs, tape sponge, sticky tape, and cassava tape."

The findings obtained in the interviews are project-based learning that is understood by the teacher, namely learning that requires students to complete problem-based projects by means of investigations that produce products. This is in line with Permendikbud No. 58 of 2014 which states that Project-Based Learning is a learning model that uses problems as a first step in gathering and integrating new knowledge based on experience in real activities. Project-Based Learning is designed to be used on complex problems that students need to investigate and understand. The syntax explained by teacher informants from various frameworks, namely from teacher informants 3 comes from the Permendikbud No. framework. 58 of 2014 and teacher resource 4 came from the Colley framework, 2008 while the syntax explained by resource 2 is unknown from the framework source.

Based on the statements of the teacher informants, it can also be seen that the teacher knows very well about project-based learning, where the end result of this learning model will produce a product but with a series of stages and thought processes. This can be seen from the teacher interviewees who stated that they had never used project-based learning even though they had produced several products in science learning. The reasons they never used project-based learning varied, namely the time it took was too long and school facilities and infrastructure were inadequate. The products produced did not originate from a problem, not from innovation from students, not through a thought

process, the teacher resource persons only gave assignments to their students to make products that had been determined by the teacher resource persons. In addition, these products were not made at school but at students' homes without being recorded, so the teacher sources only received finished products without knowing the manufacturing process.

Teacher's Perception Regarding Scientific Creativity

Based on data collection through a questionnaire, it can be seen that all respondents do not know about scientific creativity.

Teacher resource person 1 states: "I know about creativity but I just heard the term scientific creativity. I also do not know the indicators of scientific creativity. I have never trained students' scientific creativity or applied it with learning models or other learning media. I also don't know how to train students' scientific creativity".

Teacher resource person 2 states: "I just heard the term scientific creativity, I don't even know the indicators. I have never trained scientific creativity in my students and do not know how to train students' scientific creativity".

Teacher resource person 3 states: "I don't know about scientific creativity and its indicators. I have never made a project-based LKS to increase students' scientific creativity. Even I also don't know how to increase students' scientific creativity".

Teacher Resource Person 4 States:

"I already know the term creativity, but I have just heard about scientific creativity. I don't even know the indicators, so I have never made a project-based LKS to increase students' scientific creativity. I also don't know how I can train students' scientific creativity".

Based on the results of these interviews, the findings obtained were that all teacher informants did not know about students' scientific creativity, they initially equated it with creativity. Scientific creativity is the ability to be able to produce a certain product that is original and has social value or personal value, which is designed with a specific purpose in mind using existing information (Setyadin et al., 2017). In contrast to other creativity, scientific creativity is emphasized on indicators of determining the use of objects for scientific purposes, finding scientific problems, increasing the technical use of a product, scientific imagination, designing creative experiments, solving scientific problems creatively, and designing products creatively (Prahani et al., 2021; Suyidno et al., 2015). According to all teacher sources, it is necessary to increase students' scientific creativity.

Conclusion

Based on the results of the research and discussion about the perceptions of science teachers towards project-based learning of vegetable waste processing and students' scientific creativity is not appropriate. There are still many teachers who apply the lecture method in learning science. As many as 100% of teacher respondents have never implemented project-based learning because it is too difficult to implement, requires quite a long time, and the facilities and infrastructure are inadequate. As many as 100% of teacher respondents have never used real or global problems such as the problem of vegetable waste that is not managed properly in Kotaagung Timur District. As many as 100% of teacher respondents did not know about students' scientific creativity so they did not know how to improve it. Based on the overall results of questionnaires and interviews conducted with science teachers, it is necessary to develop project-based learning programs to increase students' scientific creativity because this can be useful for students in the current era of globalization.

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Author Contributions

All authors contribute to the process of completing research and writing articles. Conceived of presented the idea, the concept of the study, the design and collection of data, the analysis and interpretation of the data and the preparation of the draft of the manuscript: Anadia Rosaria. Validation of data collection instruments, data analysis and interpretation, reviewed article: Noor Fadiawati and Chansyanah Diawati. All authors reviewed the results and approved the final version of the manuscript.

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Conflicts of Interest

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