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The practicality of student worksheets on the Scientific Creativity project-based Learning (SCPjBL) model to improve scientific creativity as a creative process for Physics Education students

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Abstract

The aim of this reseach was to describe the practicality of the SCPjBL model, based on the results of the implementation of scientific investigations to improve students' scientific creativity on Student Worksheets (LKM). The method in this study is the development of a modified model and applied in universities in 2024. The sample in this study was 90 students from two different universities. Data were collected based on the results of validation and observation of the implementation of the SCPjBL model. The assessment instrument used an implementation observation sheet carried out by two observers. The observation sheet was filled in by four observers who were divided into two observers who were tasked with observing the implementation of the SCPjBL model phase, and two others observed student activities, the results of the observations were then analyzed quantitatively. The results of the study were in the form of implementation results by obtaining an average score of 3.72 with an average validity percentage of 91% with a very practical category. The results of the practicality of the SCPjBL model and its supporting devices obtained a score of 3.56 with an average implementation percentage reaching 91%. Based on the results of the study, the SCPjBL model was declared practical and feasible for use.

Keywords: Practicality, model SCPjBL, Scientific Creativity

Introduction

The development of science, especially in the field of science, requires a lecturer to adapt to the skills needed in the 21st century (Andres & Rosalinda, 2023; R. Rahayu et al., 2022). The four skills needed in this 21st century are critical thinking and problem solving, creativity and innovation, communication, and collaboration (Cheli et al., 2023). The four skills above are known as the skills of the industrial era 4.0 (4C) (Herieb, De Vries Toddi, 2017). The four skills above are in accordance with the expectations of the goals of Indonesian national education formulated in the KKNI level six, namely being able to innovate by applying the knowledge they gain. Innovation requires high-level thinking skills, the high-level thinking skills referred to are creativity(Rahmawati et al., 2021). Creativity is the ability to produce new and unusual ideas. In science, creativity is known as scientific creativity which is characterized by ideas that emerge that are scientific or have scientific reasons. Students who have high-level thinking skills (creative thinking) will find it easy to solve problems they face in the real world (Altiparmak & Eryilmaz-Muştu, 2021).

In fact, based on the results of research conducted by PISA on Indonesian students in 2018, Indonesian students are still at level 2 with a score of 396 out of a maximum score of 600. At that level, students are only able to understand a phenomenon. PISA Research In 2022 (OECD, 2023) Indonesian students' abilities in science actually decreased with a score of 382 from a maximum score of 600 (PISA, 2023). The results of the PISA research are reinforced by the results of preliminary research conducted by researchers in 2022 and 2023, the research was conducted on prospective physics teacher students. The research was conducted by giving a scientific creativity test to students of the Physics Education S1 study program at the Islamic University of Madura. Based on the results of the preliminary research, students' ability to understand scientific creativity as a creative process is still relatively low. This can be seen from the test results that most of the students, almost 90% of whom have not applied high-level thinking skills in solving scientific problems. The results of this study are also reinforced by the results of research conducted by Suyidno et al., (2020) at the University of Lambung Mangkurat, Indonesia in 2020. Based on the results of the study, some students were still unable to answer the problem-based scientific creativity test.

Based on the description of the problem above, there is a gap between what is expected by the objectives of education and the reality. Based on the results of the researcher's interview with one of the lecturers and student representatives, one of the causes of the lack of maximization in scientific creativity is the learning process which is still conventional (Cirkony, 2023; S. Rahayu et al., 2022). Learning should provide meaningful meaning to students, meaningful learning can be done if the learning process is managed well. Learning management cannot be separated from the methods, models and approaches used by lecturers (YUSTINA & SUWONDO, 2015). Based on the facts above, the researcher tried to find a solution by changing the learning system which is student-centered, in this case the researcher developed a learning model that is active and requires students to always be active and accustomed to creative thinking skills. The model developed by the researcher to overcome the above problems is a project-based learning model, project-based learning can arouse students' motivation and interest in learning (Pennequin et al., 2020). The project-based learning model is an interactive learning model that guides students to always be active in the learning process. The syntax of the Project based learning model is: 1) starting with essential questions; 2) planning project assignments; 3) designing project assignments; 4) monitoring project assignments; 5) assessing project assignment results; 6) evaluating learning experiences (Sulisworo, 2020). Based on the six syntaxes, learning can be developed to be more active.

However, based on the results of research conducted by Dwikoranto et al., (2021) and Suyidno et al., (2020), the PjBL model still has limitations in increasing scientific creativity (Ananda et al., 2023). Among them are still unable to improve the ability to explore scientific knowledge and use creative thinking guides. Therefore, researchers are trying to perfect the PjBL model in training scientific creativity (Hu & Adey, 2002).

Literature Review

Scientific creativity can be viewed as a creative process, a creative person and as a creative product. Scientific creativity as a creative person, namely someone who is creative always produces ideas that are original, flexible, and fluent in solving problems. Scientific creativity as a creative process, namely producing a product through a scientific process. The scientific process always refers to scientific knowledge, scientific knowledge is obtained through the process of exploring knowledge before scientific investigation. Scientific creativity which is viewed as a producer of innovative products, namely always refers to scientific knowledge, answers scientific phenomena, as an answer to solving problems scientifically, the resulting product has broader benefits (Ayas & Sak, 2014; Hu & Adey, 2010; Mukhopadhyay, 2013).

Research Method

This research was conducted on undergraduate students of Physics Education at a college located in East Java, Indonesia. The research sample was 90 students who took the basic physics course 1. This research is a development research that adopts the Borg & Gall development model (Borg & Gall, 1983). The research process begins with preliminary research to see the phenomena in the field, then literature analysis to strengthen the results of the preliminary research. Then, it is continued with needs analysis, designing research instruments, validating research instruments, revisions are made and then implemented at the target college. The instrument in this study is a research implementation sheet in the form of a student worksheet. The implementation sheet is distributed to two observers who are tasked with observing the research process and research constraints. After observations by two observers, it is then analyzed using the formula:

$$Score = \frac{Score\ \ obtained}{Maximum\ \ score} \times 4$$

The results of the implementation score calculation are then adjusted to the practicality score criteria as in Table 1.

Table 1. Practicality Criteria of the SiPjBL Model

Score	**Category**
$3{,}25 \leq P < 4{,}00$	Very practical
$2{,}50 \leq P < 3{,}25$	Practical
$1{,}75 \leq P < 2{,}50$	Practical enough
$1{,}00 \leq P < 1{,}75$	Less Practical

Adapted from Astutik & Prahani, (2018)

Result

The results of the practicality of the SCPjBL model in increasing scientific creativity reviewed from creativity as a creative process based on the implementation of the SCPjBL model syntax are presented in Table 2.

Table 2. Implementation of the SCPjBL Model Syntax

Phase	Observer 1	Category	Observer 2	Category
Starting with a scientific phenomenon	3.80	Very good	3,50	Very good
Planning a physics project assignment	3.90	Very good	3,00	Good
Exploration of scientific knowledge	4.00	Very good	3,80	Very good
Designing and planning project tasks	3,67	Very good	3,50	Very good
Monitor project tasks	4.00	Very good	3,55	Very good
Assessing the results	3.50	Very good	3.80	Very good
Evaluating experience	3,67	Very good	3,67	Very good
Average	**3,79**	**Very Practical**	**3,54**	**Very Practical**

Based on the results of the implementation of each phase of the SCPJBL model, table 2 shows that based on the results of observations made by observers 1 and 2, all SCPJBL model syntax has been implemented in the good and very good categories. There is phase 2 of planning a physics project assignment in the good category from observer two because observer two saw that the teaching lecturer was still less responsive to how to divide student groups. The results of the implementation of the creative process investigation can be seen in Table 3.

Table 3. Implementation of Scientific Investigation of the creative process in scientific creativity

Activities	Observer 1	Category	Observer 2	Category
Scientific phenomena	3,40	Very good	3,25	Very good
Scientific Knowledge	4,00	Very good	3,80	Very good
Problem solving ability	3,67	Very good	3,40	Very good
Creative design product ability	3,70	Very good	3,60	Very good
Technical product	3,52	Very good	3,67	Very good
Product analys	3,80	Very good	3,50	Very good
Conclusion	4,00	Very good	3,80	Very good
Average	**3,72**	**Very Practical**	**3,58**	**Very Practical**

Based on table 3, the observation of the scientific investigation process was carried out by four observers who were tasked with observing the implementation of the scientific investigation with the Student Worksheet as a reference, the results of this scientific investigation observation got an average score of 3.72 with a very practical category while the results of the second observer got a score of 3.58 with a category also very practical. These results indicate that the student worksheet is suitable for use in the implementation of the learning process with the SCPjBL model. The implementation of the SCPjBL model syntax and LKM as a whole can be seen in Figure 1.

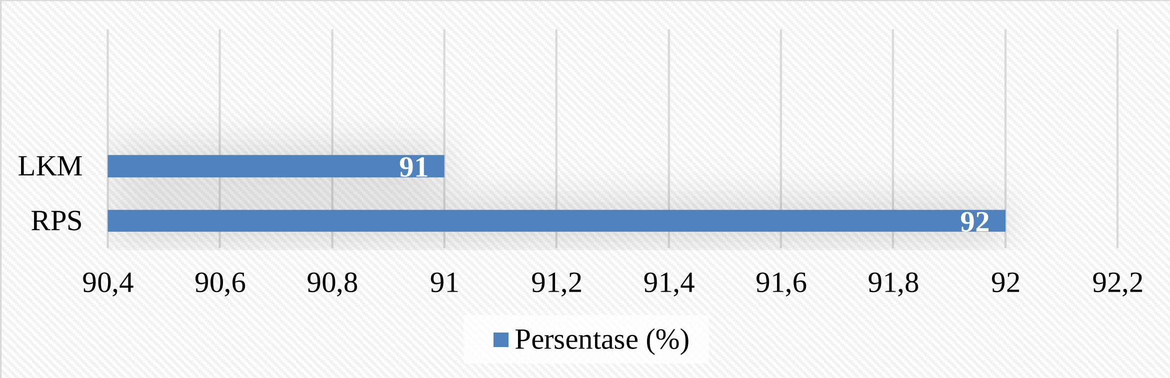

Figure 1. Percentage of implementation of Scientific Learning and Investigation model SCPjBL

Based on Figure 1 above. The percentage of implementation of the SCPjBL model syntax and Student Worksheets reached 91% and 92% respectively with the category of being implemented well.

Discussion

Based on the results of the implementation of Scientific Creativity as a creative process reviewed from the implementation of LKM, we can see in Table 1 and Table 2. The practicality of the SCPjBL model in improving scientific creativity is categorized as feasible. Student worksheets have a level of implementation reaching above 75% which is implemented very well, this indicates that the interaction between lecturers and students is very good, during scientific investigations the lecturer provides time to consult with students. This is done as a form of scaffolding (Arend, 2012). Assistance is given to students which is slowly reduced with the aim that students can be independent in solving their problems. This is in accordance with the theory put forward by Arend that providing assistance little by little to teach students to be independent can have a positive effect on meaningful learning (Moreno, 2010).

In addition to good interaction, lecturers try to create a pleasant learning environment, this is done to overcome boredom during the learning process with the SCPjBL model. A comfortable learning environment will make the mind more relaxed. During scientific investigations, students are given the freedom to think and explore knowledge in such a way. This is given to create an atmosphere of a democratic learning process (Zulkarnaen, Z.A. Imam Supardi, 2017).

Students' scientific investigation activities in the aspect of writing scientific knowledge on student worksheets scored 4.00 and 3.80. This score is one of the highest scores compared to other aspects. Students can write knowledge well because previously students had deepened their initial knowledge before conducting scientific investigations. The knowledge built at the beginning will have a positive effect on the smooth running of the project-based scientific investigation process (Sukma Anggreini et al., 2023). This is a characteristic of the development of the SCPjBL model in this study.

The obstacles to implementing scientific investigations are in the form of technical obstacles such as students still lacking time discipline when designing products, some students still need to be guided to use creative thinking techniques properly. The substantive obstacles in this study were not found. Based on the above, scientific investigations can be said to be appropriate for the physics learning process.

Conclusion

Based on the results of the study on the practicality of the SCPjBL model in improving the scientific creativity of undergraduate physics education students, it can be concluded that the SCPjBL model developed from the PjBL model has met the practical aspects. With a validity score reaching 91% it is very practical. This can be seen from the implementation of learning and the implementation of student worksheets. This development research only reaches the practical aspects of the model that has been developed, therefore it is necessary to test the level of effectiveness of this SCPjBL model.

Declaration of conflicting interest

The researcher in this reseach has no direct or indirect relationship with the manager of this journal. Second, this research is purely the result of the researcher's own work as a contribution to the development and advancement of science.

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