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The Effect of Laboratory-Based Blended-Project Based Learning Model on The Science Process Skills of Students

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Abstract

The process of learning science, especially physics, has often had problems. The problem that often arises so far in the field is how to teach teachers who still use conventional methods. This learning method has not been able to support the science learning process, which causes low science process skills in students. The purpose of this study was to determine the effect of the laboratory-based Blended-Project Based Learning (B-PjBL) model on students' science process skills. The research method used was quasi-experimental with a posttest control group design. The results of the hypothesis test using the t-test showed that the laboratory-based B-PjBL model has a positive effect on students' science process skills.

Keywords: science process skills, laboratory-based B-PjBL model

INTRODUCTION

Education is a conscious and planned effort to create a learning atmosphere and learning process, where students actively develop all their potential to be able to have various skills such as intellectual, emotional, and spiritual skills. Education aims to improve the quality of students. The quality of education has always been a major concern in order to train qualified students. However, currently, the main problem faced by the world of education is related to the quality of education, especially the quality of science learning, which is still very low. The focus of education, which mainly needs improvement, is related to education, especially the quality of education (Delimanugari, 2024).

The low quality of science learning is evidenced by the PISA 2018 study (Programme for International Student Assessment) results, showing that the science ability of students in Indonesia is still very low, ranking 71 out of 79 PISA participating countries (PISA, 2019). Of course, this condition is very concerning amid a large number of residents and resources. One solution to improve students' science skills is to grow science process skills, especially among students.

The current curriculum emphasizes strengthening the learning process. In this case, students are expected to find out, not just be told. Therefore, the stages of the learning process must really be considered and emphasized to students. The stages of the process are described in a scientific approach that is in line with the scientific method in learning science. Science learning not only emphasizes product mastery but also mastery of process skills and scientific attitudes. Process skills in science learning are known as students' science process skills (Sinuraya, Panggabean, & Wahyuni, 2019).

In its implementation, this science process skill has not been fully carried out in physics learning; this is because learning is still teacher-centered and emphasizes using mathematical formulas without involving students in knowing the formulas obtained; students practice more about doing physics problems than practicing how to get or prove physics concepts. Such learning also leads to a lack of science process skills as students are not trained to acquire knowledge directly through laboratory or practicum activities. Physics is part of science, which is essentially a collection of knowledge, ways of thinking, and investigation. Physical science is seen as a process, a product, and an attitude; this gives the meaning that what is studied is related to the view of physics as a product, whereas how to study it if physics is seen as a process. Likewise, students' scientific attitudes in experimental or laboratory activities are integral to science learning (Sinuraya, Panggabean, & Wahyuni, 2019).

The laboratory is usually defined as a place of experimentation in conducting testing and analyzing and a place to make observations or practicum. Basically, activity in the laboratory is part of Science Learning. Science learning Has characteristics, namely designing and assembling an experimental instrument, collecting tools and materials, processing data, interpreting data, structuring reports, as well as communicating the results both orally and in writing (Nurdiansah & Makiyah, 2021). According to (Wilcox & Lewandowski, 2017), laboratory activities are very important in the physics curriculum and recommended for implementation directly in physics learning and can improve the quality of learning science.

Science learning needs to emphasize science process skills (SPS) in students because science is essentially built based on scientific products, scientific processes, and scientific attitudes. Science as a process has meaning as a method of obtaining knowledge or having a process to obtain knowledge related to nature and science. This science process skill has various definitions from experts, including, according to Jatmika, Lestari, Rahmatullah, Pujianto, and Dwandaru (2020), explaining that SPS is all processes carried out related to science. Hardiyanti (2020) stated that science process skills are the ability of students to apply the scientific method to understand and discover science, as well as develop science. Therefore, it is hoped that students have science process skills to improve the quality of education in Indonesia. This is in line with the opinion of Darmaji, Astalini, Kurniawan, and Putri (2022), which states that education in Indonesia must be directed at the ability of students to be able to understand meaningful learning processes through scientific knowledge or science process skills.

Science process skills are all-encompassing skills possessed by students, including cognitive, psychomotor, and affective skills based on scientific methods that students can build on themselves. These science process skills include a number of skills that are not separated; each of these skills is specifically present, emphasizing the indicators of each aspect of science process skills; the following aspects of science process skills include making observations (observations), grouping (classification), interpreting observations (interpretation), forecasting (prediction), asking questions, hypothesizing, planning experiments or investigations, using tools and materials, applying concepts or principles, communicating (Rustaman, 2007). According to Zamista and Kaniawati (2015), one of the reasons for the fundamental importance of students' science process skills in teaching and learning activities is training students to develop scientific attitudes in students.

The development of science and technology in 21st-century education has led to a paradigm shift in learning. The quality of learning in this era is mainly determined by the integration of technology, information, and communication (Putra, Sumarmi, Deffinika, & Islam, 2021). Technology can help strengthen students' learning process; teachers are not only responsible for the learning process but can build effective and collaborative relationships with digital. The success of technology integration in learning can be seen in the ability of teachers to design teaching materials. The application of learning models in the classroom is the main key to achieving learning objectives. Two of the relevant learning models are blended learning (BL) and project-based Learning (PjBL). According to some references, applying the B-PjBL model directs students to be actively involved in the learning process by involving project work as an alternative to solving an Issue or assigned task. The combination of Blended Learning and Project-Based Learning into Blended-Project Based Learning (B-PjBL) is something new in the process of Learning. Project-based learning (PBL) is a new type of instruction that focuses on heuristics, collaboration, and exploration and is an essential way to develop students' basic reading skills in the modern era (Gu & Zhang, 2024). The Blended-Project Based Learning Model is a Project-based learning activities that incorporate face-to-face learning face-to-face with technology-assisted online learning. Learning-based Face-to-face and online projects have the potential to foster learning and become meaningful (Mustaji, Masitoh, & Pradana, 2022). Combining online learning with a project-based learning model allows the search for information to be broad and even cross-disciplinary. This will allow students to search for additional information over the Internet, expanding their knowledge through problem-solving and project development using Internet technologies. In addition, project-based learning carried out face-to-face and online can improve learning outcomes, creative thinking, and student learning motivation (Rahardjanto, Husamah, & Fauzi, 2019).

Some of the results of previous research on the Blended Project Based Learning (B-PjBL) model conducted by Djumadi, Astuti, Agustina, and Kusmadani (2021) concluded that Blended-Project Based Learning (B-PjBL) learning is needed in science learning in high schools both at the junior and senior high school levels because it is able to solve problems and improve students' critical thinking skills. Research by Putra, Sumarmi, Deffinika, and Islam (2021) stated that there was a significant influence of the B-PjBL model with a STEM approach on spatial thinking skills and geography skills of students at SMA Negeri 1 Kepanjen Malang, East Java, Indonesia. The research of Salma, Basori, and Hatta (2020) concluded that there was a significant increase in learning outcomes of SMK students using blended project-based learning.

From the description above, one way to overcome the low skills of the student science process and be able to follow the development of information technology is with the Blended-Project Based Learning (B-PjBL) model combined with laboratory activities. This model will make physics learning more interesting because students are invited directly to make a project in the form of a physics practicum tool with learning carried out face-to-face in class and online through e-learning, then students can prove directly a physics concept from trials with projects they make through the science process so that students can be directly involved in the learning process and be able to develop skills process, science students. This is in line with the research of Dwikoranto et al. (2020) stated that the laboratory-based Project Based Learning (PjBL) learning model learning model is an innovative learning model designed to improve the skills of the science process and creativity of students. Next opinion, Tong, Kinshuk, & Wei (2020) state that B-PjBL can improve students' learning ability independence and inquiry ability (experimental ability), in this case, students' science process skills.

Based on this, this study aimed to determine the effect of the laboratory-based Blended-Project Based Learning (B-PjBL) model on students' science process skills.

METHOD

This research was carried out at SMA Negeri 9 Kota Tasikmalaya in class X science odd semester of the 2022/2023 academic year. The population in this study was all students of grade X science consisting of four classes with a total of 144 students. Sample selection in this study used a cluster random sampling technique. This technique is used so that the researcher gives each subject equal rights to the opportunity to be selected as a research sample. Based on the results of the draw, class X IPA 1 was taken as an experimental class that carried out learning with a laboratory-based Blended-Project Based Learning (B-PjBL) model, and class X IPA 2 as a control class that carried out learning using a laboratory-based Direct Instruction model. This type of research is quasi-experimental with a posttest-only control design research design. The research design can be seen in Table 1 (Sugiono, 2018).

Table 1. Research Design

Class	Treatment	*Posttest*
Experiment	X_1	O_1
Control	X_2	O_2

Information:

- X_1 : Treatment of the learning process for experimental classes applied to the laboratory-based Blended Project Based Learning (B-PjBL) model.
- X_2 : The treatment of the learning process for control classes is implemented with a laboratory-based Direct Instruction model.
- O_1 : final test after treatment (posttest) in the experimental group.
- O_2 : final test after treatment (posttest) in the control group.

In this study, there were two variables, namely bound variables and free variables. The bound variable in this study is the science process skills of students. the free variable in this study is laboratory-based Blended Project Based Learning (B-PjBL). The data in this study was obtained using a valid 15-question description instrument. The question instrument has been validated by expert validators and tested the test instrument to students of class XI IPA 1 SMA Negeri 9 Tasikmalaya, West Java, Indonesia, who have studied parabolic motion material. The analysis of science process skill test instruments is presented in Table 2.

Table 2. Science Process Skills Test Grid

SPS Aspects	Question Indicators	Item No
Observe	Observe phenomena that are included in the type of parabolic motion based on the images presented.	1
	Observe the characteristics of parabolic motion in the x-axis direction of the graph presented.	2
Classify	Classifies each condition point on the trajectory of motion of a parabola based on the figure presented	3
Forecast or predict	Predicts the occurrence of regular straight motion on the x-axis when the ball hits a wall in parabolic motion.	4
Hypothesis	Hypothesized the relationship of initial velocity to elevation angle at maximum altitude of rugby game.	5
	Hypothesize which ship was hit first based on the concept of parabolic motion.	6
Ask a question	Ask questions related to the relationship of elevation angle to the maximum height of the description and figure presented.	7
Plan an experiment	Plan experiments by determining the tools and materials contained in simple practicum tools for parabolic motion experiments.	8
	Plan the experiment by arranging the steps of the parabolic motion experiment appropriately.	9
Using tools and materials	Using tools and materials that are in accordance with the function and use of simple practicum tools in parabolic motion experiments.	10,11
Apply the concept	Apply the concept of maximum height to parabolic motion by determining the ball's maximum height after reflection from the floor.	12
Conclude	Based on the data presented, infer the relationship between elevation angle and maximum height.	13
	Deduce the highest kick from the difference in each soccer player's kick from the data presented based on the concept of maximum height.	14
Communicate	Illustrates the graph of the elevation angle relationship to the farthest point (Xmax) based on the data presented.	15

Test questions are arranged based on an indicator grid of each aspect of science process skills. The test is used to measure the extent to which the achievement of indicators contained in science process skills on learning material delivered using a Laboratory-based Blended-Project Based Learning (B-PJBL) model. The aspects used to measure science process skills in this study include 10 aspects of SPS, as in the table above.

The science process skill test instrument has been tested through instrument validity tests and instrument reliability tests. The question validity test is a measure that shows the level of validity and validity of an instrument. Measurement of instrument validity in this study using Pearson Product Moment correlation with the help of Microsoft excel. Reliability testing is a tool that can be said to have high confidence if it can provide fixed results. To test the reliability of the test instrument in this study, use the Cronbach Alpha formula.

Then, the data analysis technique used to determine the effect of the laboratory-based Blended-Project Based Learning (B-PjBL) model on students' science process skills in this study uses prerequisite tests (normality tests, homogeneity tests) and hypothesis tests (t-tests).

Data analysis of each aspect of science process skills was carried out to determine the low improvement of students' science process skills based on the tests given. The results of the science process skills test data obtained later gave a score based on scoring guidelines for each question item based on the criteria that have been made, which further calculates the percentage of Question item answers for each aspect of science process skills. The data obtained are interpreted into science process skill assessment criteria as in Table 3 (Arikunto, 2015).

Table 3. Science Process Skills Assessment Criteria Category

Percentage	Category
81 – 100	Very High
61 – 80	High
41 – 60	Medium
21 – 40	Low
0 – 20	Very Low

RESULT AND DISCUSSION

The relationship between the syntax of the Project Based Learning (PjBL) and Blended-Learning models, as stated by Hariyono and Andrini (2020b), which collaborated with laboratory activities on students' science process skills, can be seen in Table 4.

Table 4. Linkage of Laboratory-Based Blended-Project Based Learning (B-PjBL) Syntax with Science Process Skills

Learning Syntax	Implementation of Learning	Learning Activities and Skill Aspects of the Science Process
Step 1 (Starting with an essential question)	Face-to-face	Starting with an in-depth investigation in the form of essential questions, students are directed to observe, classify, and hypothesize related to the questions given by the teacher to provoke students' knowledge, responses, criticisms, and ideas about the project theme to be raised. The material studied includes the concept of parabolic motion and the characteristics of parabolic motion
Step 2 (Planning project work rules)	Face-to-face	Selection of learner activities that support answering important questions through projects to be created and planning experiments. Then, the teacher provides guidance on making projects from beginning to end and student worksheets. The material studied is about the concepts of initial speed, elevation angle, maximum height, and maximum range.
Step 3 (Create an activity schedule)	Face-to-face	Develop an activity schedule during the learning process, with students able to predict how long it will take to complete the project task.
Step 4 (Monitoring the progress of the learner project)	E-Learning	The teacher guides the students to do the exercises. Then, the teacher provides opportunities for students to practice concepts or skills through laboratory/practicum activities using simple cannon props to prove the concept of parabolic motion, including the relationship of elevation angle with maximum reach and the relationship of initial speed with maximum height according to the instructions in the student worksheet given. The teacher's role at this stage is to monitor and provide guidance if needed.
Step 5 (Assessment of student work)	Face-to-face/ E-Learning	Students prepare projects that have been made for trial by applying the concepts being studied through laboratory/practicum activities and using tools and materials by their functions. Furthermore, students report

Learning Syntax	Implementation of Learning	Learning Activities and Skill Aspects of the Science Process
		the project that has been made and the results of the experiment in the form of videos to the teacher and percentages in class to other students will later stimulate students to communicate with questions and answers with each other.
Step 6 (Evaluation of students' learning experiences)	Face-to-face	At the end of the learning process, students are directed to reflect and draw conclusions on experimental activities and project results that have been made.

The first syntax, starting with questions that are essential with face-to-face learning in the classroom, in this syntax can facilitate aspects of science process skills, namely the aspects of observing, classifying, and hypothesizing. This syntax displays images and videos on the projector screen when a basketball player is throwing a ball into the hoop and gives an essential question in conjunction with the concept of parabolic motion. After being given pictures, videos, and questions, students are directed to observe the images presented by the teacher, classify the characteristics of parabolic motion, and hypothesize how basketball can enter the basketball hoop according to the concept of parabolic motion. This is in line with the opinion of Hutagalung and Koto (2020) who state that the learning process using video is able to improve learning outcomes and student science process skills, especially in the aspect of observing. Furthermore, the opinion of Mahmudah (2016) states that classification skills can be curated if students are able to identify groupings of objects that can be carefully observed with their sensory devices. And the opinion of Mahmudah (2016) states that hypotheses can be formulated by deductive reasoning based on theory.

The second syntax, planning the rules of project work with learning carried out face-to-face in the classroom, in this syntax can facilitate aspects of science process skills, namely the aspect of planning experiments. In this step, students collaboratively with their group mates plan the project to be created and experiment with activities using the project. This can foster the practical ability of students and the ability to work. This is in line with the opinion of Tong, Kinshuk, and Wei (2020), who stated that using the Blended-Project Based Learning (B-PjBL) model can improve students' practical and application skills and grow students' teamwork skills more effectively.

The third syntax, making a schedule of activities with learning carried out face-to-face in the classroom, in this syntax can facilitate the skill aspect of the science process, namely the predictive aspect. This syntax allows teachers and students to schedule learning activities during project work and directs students to be able to predict how long it will take to complete the project task. This agrees with Maghfiroh, Susilo, and Gofur (2016), stating that predicting is one of the important aspects of science process skills because the aspect of predicting is by the steps of compiling a schedule in the project-based learning step.

The fourth syntax, monitoring the development of student projects with learning carried out through e-learning, in this syntax can facilitate aspects of science process skills, namely the aspect of asking questions. This syntax is that the teacher is responsible for monitoring the activities of students through google classroom in carrying out project tasks that are carried out, providing group discussion stalls if there are obstacles during the project creation process and experiments carried out. This will stimulate students to ask questions. This agrees with Shodiq and Zainiyati (2020); through e-learning, students can ask freely about the problems they face to get the best solution so that initially passive students will change to be more active.

The fifth syntax, the assessment of the work of students with learning is carried out face-to-face in the classroom and through e-learning. This syntax can facilitate aspects of science process skills, namely the aspect of applying concepts, using tools and materials, and communicating. In this step, students prepare projects that have been made to be tested through laboratory/practicum activities by applying the concept of parabolic motion that has been studied and using project tools and materials in accordance with their functions. This is in line with Hardiyanti's opinion (2020) stating that students are more likely to easily understand the concepts learned in class through laboratory or practicum activities. Furthermore, students report the project that has been made and the results of the experiment in the form of videos to the teacher and presentations in class to other students to stimulate students to communicate with each other with questions and answers. This agrees with Hendriyani and Novi (2020) stated that reporting experimental results can be more interesting when based on audio-visual because it can facilitate various learning styles and information delivery carried out by students.

The sixth syntax, the evaluation of the learning experience of students with learning is carried out face-to-face in the classroom. This syntax can facilitate the skill aspect of the science process, namely the aspect of inference. At the end of the learning process, students are directed to reflect and draw conclusions on experimental activities and project results that have been made. Furthermore, the teacher asks students to express their feelings and experiences while working on the project from start to finish. So that students will independently be able to be actively involved in the learning process, and their knowledge and skills can develop better. This is in line with the opinion of Kurniasari (2017), who stated that the project-based learning model provides opportunities for students to independently explore content (material) in various meaningful ways.

The learning syntax for the control class is to use the Direct Instruction model as initiated by Bruce and Weil (1996) in Salmawati (2016), which collaborated with laboratory activities, as displayed in Table 5.

Table 5. Laboratory-based Direct Instruction Model Syntax

Learning Syntax	Learning Activities
Orientation	At this stage, the teacher provides a lesson framework and orientation to the material to be delivered in the form of initial understanding to students related to parabolic motion material, explaining learning objectives, and informing the material/concepts to be used and activities to be carried out during learning. For example, students are presented with images and videos on a projector screen when a basketball player throws a ball into the hoop and asks important questions in conjunction with the concept of parabolic movement.
Presentation	At this stage, the teacher presents the subject matter in the form of parabolic motion concepts, including initial speed, elevation angle, maximum height, and maximum range, as well as skills.
Guided and Structured Exercises	The teacher guides the students to do the exercises. Then, the teacher provides opportunities for students to practice concepts or skills through laboratory/practicum activities using simple cannon props to prove the concept of parabolic motion, including the relationship of elevation angle with maximum reach and the relationship of initial speed with maximum height according to the instructions in the LKPD given. The teacher's role at this stage is to monitor and provide guidance if needed.
Self-Practice	At this stage, the teacher provides practice questions related to the material that has been learned independently.

Based on the table above, the laboratory-based Direct Instruction model can influence students' science process skills because it is facilitated by laboratory or practicum activities at the stage of structured and guided exercises. This is in line with the opinion of Siswono (2017), who states that the involvement of students in the laboratory/practicum is able to stimulate students to bring out and develop potential scientific process skills in students, especially improving cognitive, psychomotor and affective aspects. However, this laboratory-based B-PjBL model is superior to the laboratory-based Direct Instruction model, this is proven through research results. The following are the results of research and data analysis on process science skills in experimental and control classes can be seen in Table 6 below.

Table 6. Statistical Data of Research Results and Data Analysis of Science Process Skills in Experimental and Control Classes

Value	Control class	Experimental class
Minimum	33	37
Maximum	50	54

Average	39.33	45.08
Variance	18.79	23.62
Standard Deviation	4.01	4.70
$x^2_{calculate}$	7.64	10.48
x^2_{table}	12.80	12.8
$F_{calculate}$		1.26
F_{table}		1.77

Based on the data above, the average scores of the two groups show that the experimental class using the laboratory-based B-PjBL learning model is better than the control class using the laboratory-based direct instruction learning model. This is in line with the research of Chasanah, Khoiri, and Nuroso (2016), who stated that there are differences in the science process skills of students who follow project-based learning models and those who follow direct instruction learning.

The normality test is carried out with the aim of knowing whether data comes from a normally distributed population or not. This test was carried out on posttest data that had been obtained in both the experimental class and the control class. In this study, the normality test was carried out using the chi-squared test (x^2). Based on the results of the data in Table 6, the value of $x2_{calculates}$ < $x2_{table}$ in both the experimental class and the control class, Ho, is accepted so that it can be concluded that all data groups that have been taken from the population are normally distributed.

The homogeneity test is carried out to know the variants that a group has whether it is homogeneous or not. This test is carried out on the posttest data that has been obtained. The homogeneity test was carried out using the Fisher test (*F)*. Based on the data in Table 6, the values of $F_{calculates} < F_{table}$ are accepted by Ho, so it can be concluded that all data groups have the same variance or homogeneous.

Based on the results of the prerequisite tests that have been carried out, it can be concluded that both data groups have been taken from normally distributed populations, and the two variance data groups are homogeneous. So next, hypothesis testing is done using independent sample t-tests can be seen in Table 7.

Table 7. Hypothesis Test Results (t-test)

Data	$t_{calculate}$	t_{table}	Significant Level
Skor *posttest* science process skills (experimental-control)	5,43	1,67	95%

Table 7, shows the results of the calculation of the hypothesis test using the t-test with the degree of significance (α=0.05) obtained $t_{calculates} > t_{table}$ so that Ha is accepted and Ho is rejected. This means that at a 95% confidence level, it can be concluded that there is an influence of the laboratory-based Blended-Project Based Learning (B-PjBL) model on the science process skills of students in grade X of SMAN 9 Tasikmalaya for the 2022/2023 school year. This is because the laboratory-based Blended-Project Based Learning (B-PjBL) model can stimulate students to play an active role in designing a project directly in groups based on the problems faced through science process skills, which then students test the project through experiments or practicums to directly prove a physics concept that is being studied so that the learning activity can develop skills science process in students. The involvement of students in the laboratory/practicum can stimulate students to bring up and develop the potential scientific science process skills in students, especially improving cognitive, psychomotor, and affective aspects (Siswono, 2017). This is reinforced by the results of research conducted by Dwikoranto et al. (2020) which states that the laboratory-based Project Based Learning (PjBL) learning model significantly influences students' science process skills and creativity. In addition, the results of research conducted by Kasdum (2019) stated that the Project Based Learning (PjBL) learning model affects the science process skills of students in the experimental class compared to the control class.

Based on a comparative analysis of the average percentage of posttest scores of each aspect of science process skills in experimental and control classes can be seen in Figure 1.

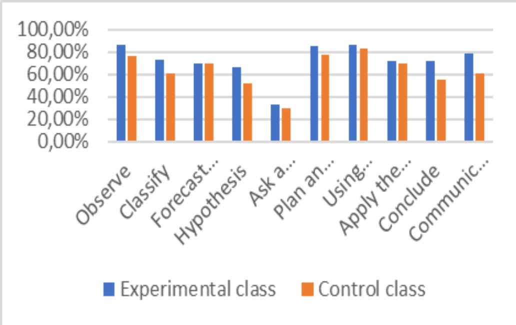

Figure 1. Comparison of the Average Percentage of Posttest Scores of each Aspect Science Process Skills in Experimental and Control Classes

Based on the data analysis comparing the percentage of posttest scores of each aspect of science process skills as shown in Figure 1 above, posttest results in control classes using laboratory-based Direct Instruction models can affect students' science process skills because in the learning process, both in experimental and control classes both carry out laboratory and practicum activities so that the posttest results of students' science process skills are not far away different. However, the posttest results of students' science process skills in experimental classes using the laboratory-based B-PjBL model were superior to control classes using the laboratory-based Direct Instruction model. This is because the learning process in the experimental class is student-centered. While in the control class, the learning process has not been student-centered and is still teacher-centered.

The direct Instruction model directs learning that is more teacher-centered and fully controlled by the teacher so that students only receive material and instruction without any effort to find additional information related to the material being studied. The Laboratory-Based Project Learning (PjBL) model, especially in the aspect of time intensity, is facilitated by Blended Learning by emphasizing the concept of no limits, both space and time, to support the student-centered learning process. Students become more independent and active in the learning process because it allows them to find additional information via the Internet and expand their knowledge through problem-solving, project development, and practicum activities without being constrained by time. This is in line with the opinion expressed by Mustaji, Masitoh, & Pradana (2022), stating that the implementation of the PjBL model, which is carried out face-to-face and online, is expected to coordinate space and time constraints by the role of digital technology in supporting learning and learning. In addition, Tong, Kinshuk, and Wei (2020) stated that B-PjBL can improve students' self-study ability and inquiry ability (experimental ability). As a result, although in the control class with the Direct Instruction model, there are laboratory activities that can stimulate students to bring up and develop potential science process skills, students' science process skills have not been trained properly. Other causes in experimental classes using B-PjBL models Laboratories are superior in influencing students' science process skills because of syntax laboratory-based B-PjBL models are able to train every aspect of good science process skills, as well as worksheet given in class Experiments are geared towards training every aspect of students' science process skills.

CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that the laboratory-based Blended-Project Based Learning (B-PjBL) model has a significant effect on students' science process skills. This Blended-Project Based Learning (B-PjBL) model is the right learning model to be used in accordance with the conditions of the development of science and technology in 21st-century education because this learning model guides students to learn actively and provides meaningful experiences in the learning process and expands students' knowledge through problem-solving and project development using internet technology. This laboratory-based B-PjBL model is recommended to be applied in physics subjects, especially subject matter where there are no practicum tools so that the projects made can be used as tools for doing a practicum. The laboratory-based B-PjBL model can also be recommended as a strategy to train science process skills in students because each step of this laboratory-based B-PjBL model is able to stimulate students to trigger and develop the potential of scientific process skills in students.

REFERENCES

Arikunto Suharsimi. (2015). Evaluasi Dasar Pendidian. Jakarta: Bumi Aksara.

Darmaji, Astalini, Kurniawan, D. A., & Putri, W. A. (2022). Science Process Skills and Critical Thinking Ability Assessed from Students' Gender. *Jurnal Pendidikan Fisika Indonesia*, 18 (1). 83-95.

Delimanugari, D. (2024). Development of Project-Based Learning E-Modules with Local Wisdom Content in Grade IV Science Lessons (IPAS). *IJBER: International Journal of Basic Educational Research*, 1(1). 11-19.

Djumadi, Astuti, Agustina, L., & Kusumadani, A. I. (2021). Model Pembelajaran Sosiosaintifik *Blended Project-Based Learning* (B-PJBL) dalam Pembelajaran IPA di SMP/MTS Se-Boyolali. *Jurnal TUNAS: Jurnal Ilmiah Pengabdian kepada Masyarakat*, 3(1). 134-140.

Dwikoranto, Munasir, Setiani, R., Suyitno, Surasmi, W. A., Tresnaningsih, S., & Pramonoadi. (2020). Effectiveness of Project Based Laboratory Learning to Increase Student's Science Process Skills and Creativity. *Journal Of Physics: Conf Series*. 1491. Doi:10.1088/1742-6596/1491/1/012006. 1-12.

Chasanah, A. R. U., Khoiri, N., & Nuroso, H. (2016). Efektifitas Model *Project Based Learning* terhadap Keterampilan Proses Sains dan Kemampuan Berpikir Kreatif Siswa pada Pokok Bahasan Kalor Kelas X SMAN 1 Wonosegoro Tahun pelajaran 2014/2015. *Jurnal Penelitian Pembelajaran Fisika*, 7(1), 19-24.

Gu, X. & Zhang, W. (2024). Research Status and Trends of Project-Based Learning in China and Abroad. *Proceedings of the 3rd International Conference on Internet Technology and Educational Informatization*. Doi:10.4108/eai.24-11-2023.2343541. 1–8.

Hardiyanti, P. (2020). Analisis Keterampilan Proses Sains Melalui Pembelajaran Berbasis Praktikum Pelajaran IPA Pada Peserta Didik Kelas VII Di Mts Negeri 1 Bandar Lampung. (Skrpsi diterbitkan). Program Sarjana Universitas Islam Negeri Raden Intan, Lampung.

Hariyono, & Andrini, V. S. (2020b). Development Of Project-Based Blended Learning (PjB2L) Model to Enhance the Ability of Technopreneurs in Higher Education. *International Journal of Advanced Research and Publications*, 4(4), 86–91.

Hutagalung, F. M., Rohadi, N., & Koto, I. (2020). Upaya Meningkatkan Hasil Belajar Dan Keterampilan Proses Sains Melalui Model Pembelajaran Berbasis Masalah Menggunakan Video Pembelajaran Pada Materi Fluida Statis. *Jurnal Kumparan Fisika*, *3*(2), 171–180.

Jatmika, S., Lestari, S., Rahmatullah, Pujianto, & Dwandaru, W. S. B. (2020). Integrasi *Project Based Learning dalam Science Technology Engineering and Mathematics* untuk Meningkatkan Keterampilan Proses Sains dalam Pembelajaran Fisika. *Jurnal Pendidikan Fisika dan Keilmuan (JPFK)*, 6(2). 107-119.

Kasdum, S. (2019). Pengaruh Model *Project Based Learning* Terhadap Keterampilan Proses Sains Peserta Didik Pada Materi Fluida Statis di SMA Negeri 1 Kluet Tengah. (Skripsi diterbitkan). Program Sarjana Universitas Islam Negeri Ar-Raniry Darussalam, Banda Aceh.

Kurniasari, R. D. (2017). Penerapan Model Pembelajaran *Project Based Learning* Untuk Meningkatkan Hasil Belajar Fisika dan Keterampilan Proses Sains Peserta Didik Kelas X Sma N 1 Banguntapan. (Skripsi diterbitkan). Program Sarjana Universitas Negeri Yogyakarta.

Maghfiroh, N., Susilo, H., & Gofur, A. (2016). Pengaruh *Project Based Learning* Terhadap Keterampilan Proses Sains Siswa Kelas X Sma Negeri Sidoarjo. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, 1(8), 1588-1593.

Mahmudah, L. (2016) Pentingnya Pendekatan Keterampilan Proses Pada Pembelajaran Ipa Di Madrasah. *Elementary Islamic Teacher Journal*, 4(1), 168-187.

Mustaji, M. S., & Pradana, H. D. (2022). Development of hybrid project-based learning in State University of Surabaya. *Proceedings Innovation on Education and Social Sciences*. 11-18. DOI 10.1201/9781003265061.

Nurdiansah, I., & Makiyah, Y. S. (2021). Efektivitas Modul *Hybrid Project Based Learning* (H-Pjbl) Berbasis Laboratorium Untuk Meningkatkan Keterampilan Proses Sains Siswa. *Jurnal Pendidikan Fisika dan Teknologi*. 7(2), 104-110.

PISA, O. (2019). Results, Combined executive summaries. Volume I, II, & III Paris, France: OECD.

Putra, A. K., Sumarmi, Deffinika, I., & Islam, M. N. (2021). The effect of blended project-based learning with stem approach to spatial thinking ability and geographic skill. *International Journal of Instruction*, 14(3), 685-704.

Rahardjanto, A., Husamah, & Fauzi, A. (2019). Hybrid-PjBL: Learning Outcomes, Creative Thinking Skills, and Learning Motivation of Preservice Teacher. *International Journal of Instruction*, 12 (2) 179 – 192.

Rustaman, N. (2007). Keterampilan Proses Sains. Bandung: Uniiversitas Pendidikan Indonesia.

Salmawati. (2016). Perbandingan Penerapan Model Ingkuiry Dan Model Pembelajaran Langsung Terhadap Hasil Belajar IPA Konsep Organ Tubuh Manusia dan Hewan Pada Murid Kelas V SD Inpres Katangka 1 Kec Somba Opu Kab. Gowa. (Skripsi diterbitkan). Program Sarjana Universitas Muhammadiyah Makassar.

Salma, W. A., Basori, & Hatta. (2020). The Effectiveness and effect of Project-Based Blended Learning on Student Achievement in Online Learning. *Indonesian Journal of Informatics Education*. 4(1). 1-8.

Shodiq, I. J., & Zainiyati, H. S. (2020). Pemanfaatan Media Pembelajaran E-Learning Menggunakan Whastsapp sebagai Solusi Ditengah Penyebaran Covid-19 di MI Nurulhuda Jelu. *Al-Insyiroh: Jurnal Studi Keislaman*, *6*(2), 144–159.

Siswono, H. (2017). Analisis Pengaruh Keterampilan Proses Sains Terhadap Penguasaan Konsep Fisika Siswa. Momentum. *Physics Education Journal*, 1(2), 83–90.

Sinuraya, J., Panggabean, D. D., & Wahyuni, I. (2019). Analisis Hubungan Keterampilan Proses Sains dan Kreatifitas dengan Hasil Belajar Kognitif Melalui Penggunaan LKM Berorientasi Icare Pada Pembelajaran Matakuliah Fisika SMA. *Jurnal Pendidikan Fisika.* 8(2), 91-96.

Tong, Y., Kinshuk, & Wei, X. (2020). Teaching Design and Practice of a Project-Based Blended Learning Model. *International Journal of Mobile and Blended Learning*, 12(1), 33-50.

Wilcox, B. R., & Lewandowski, H. J. (2017). Developing Skills Versus Reinforcing Concepts in Physics Labs: Insight from A Survey Of Student Beliefs About Experimental Physics. *Physical Review Physics Education Research*. 13(1). 010108-1-9.

Zamista, A. A. & Kaniawati, I. (2015). Pengembangan Tes Keterampilan Proses Sains Materi Fluida Statis Kelas X SMA/MA. *Prosiding Seminar Nasional Fisika (E-Journal)*. 4(5). 1-6.