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The Influence of a Project-Based Learning Model Oriented to Socioscientific Issues on Student Learning Outcomes in View of Self-Efficacy

I Kadek Alit Wirawan[1*], Ida Bagus Putu Arnyana[1], I Wayan Subagia[1]

[1]Ganesha University of Education (Postgraduate Program), Master of Science Education Study Program, Singaraja, Buleleng, Indonesia.

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Corresponding Author:
I Kadek Alit Wirawan
alitwirawan14@gmail.com

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Abstract: This research aims to describe and explain: 1) differences in student learning outcomes; 2) differences in student learning outcomes in terms of high self-efficacy and; 3) differences in student learning outcomes in terms of low self-efficacy using a socioscientific issue-oriented project-based learning model with direct learning. This type of research is a quasi-experiment with a matching pretest-posttest control group design. The population in this study were all students in class X of SMA Negeri 2 Abiansemal for the 2022/2023 academic year, consisting of 11 classes. Research sampling was based on class-matching techniques. The data in this study was collected using a self-efficacy scale and learning outcomes tests. The data in this research are student learning outcome scores and student learning outcome scores in terms of students' high and low self-efficacy which were analyzed using the Two-Way Analysis of Covariance (ANAKOVA) test with LSD follow-up test. The results of this research show that: 1) there are differences in the learning outcomes of students who follow the socioscientific issue-oriented project-based learning model with an average learning outcome score of 84.85 in the high category and higher than the control group of 72.02 in the high category with a significance value of 0.000 <0.05; 2) there are differences in the learning outcomes of students with high self-efficacy who follow the socioscientific issue-oriented project-based learning model with an average learning outcome score of 91.76 in the very high category and higher than the control group of 81.95 in the high category with a significance 0.000 < 0.05, and; 3) there are differences in the learning outcomes of students with low self-efficacy who follow the socioscientific issue-oriented project-based learning model with an average learning outcome score of 79.41 in the high category and higher than the control group of 75.10 in the high category

Keywords: Learning outcomes; Project-based learning model oriented towards socioscientific issues; Self-efficacy

Introduction

Education plays a very important role in improving the quality of human resources. Quality human resources are expected to be able to compete in the era of Industrial Revolution 4.0 which coexists with the use of digital technology and 21st-century learning skills. 21st-century or 4C skills include creative thinking skills, critical thinking and problem-solving, communication, and collaboration (Jannah & Atmojo, 2022; Partono et al., 2021). Students are required to have high-level thinking skills in order to be able to create human resources that are able to face the challenges of the times (Insyasiska et al., 2015; Kristiyono, 2018; Syahria et al., 2022). Preparing human resources to be ready to compete in the mastery and development of science and technology, learning Natural Sciences (IPA) has an important role (Sari et al., 2022). Sudarisman (2015) believes that science is very important in all aspects of life. The role of science, especially Biology, for future life is very strategic, especially in preparing future students who are critical, creative, competitive, able to solve problems, and have

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the courage to make decisions quickly and precisely, so that they are able to survive productively in the midst of the fast wave of competition in the global digital era. which is full of opportunities and challenges. In order to create competitive and competitive human resources, continuous improvement in the quality of education is needed (Amanda *et al*., 2014). Changes in educational vision and strategy in order to prepare Indonesian society to be able to provide answers to global challenges and global opportunities have become a necessity (Jaimah, 2022). The 21st century is often referred to as the century of science and technology which requires a lot of skills. Learning in the current era must emphasize changes from 1) learning patterns that previously focused on teachers to focusing on students, searching for material information independently, and recognizing one's abilities, therefore learning activities like this are considered to train students' skills in various activities or fields; 2) changing the pattern of a memorizing activity into an activity of searching and developing concepts independently, this will help students train their skills and abilities to solve problems, be creative, critical and think deeply; 3) changing individual learning patterns into cooperative learning groups, so that students can socialize well with their environment (Lestari & Ilhami, 2022; Maula et al., 2014). This hope is in line with the efforts made by the government to improve the quality of education, namely by changing the curriculum. Several curricula have been implemented, namely, the Education Unit Level Curriculum (KTSP), the 2013 Curriculum until now the Independent Curriculum has been implemented.

According to Minister of Education and Culture Regulation No. 22 of 2020 explains that the curriculum formed by the Independent Learning Policy will be flexible, competency-based, focused on developing character and soft skills, adapting to world needs, and an assessment system that supports the improvement and progress of learning outcomes. The learning outcomes achieved by students become a benchmark for achieving learning objectives. Learning outcomes become a reflection of abilities after students complete the learning program through interaction with various sources and learning environments and can be used as an indicator of the success of the learning process (Permatasariet al., 2022; Sari et al., 2022).

The learning process through the Merdeka Curriculum emphasizes student-centered learning, the teacher is no longer the center of learning but becomes a facilitator who helps facilitate students to explore their own knowledge (Hakiky et al., 2023). Students as the center of learning is not something new in the curriculum in Indonesia, but its realization can be clearly implemented in the Merdeka Curriculum. This can be observed through the project-based learning process in this curriculum, such as making prototypes of teaching aids and using authentic assessments (Rahmayumita & Hidayati, 2023). One of the main characteristics of an independent curriculum is project-based learning (Meliniasari et al., 2023).

Project-based learning is a learning model that produces a product. Project-based learning is a learning model that has long-term activities involving students in designing, creating and displaying products to solve real-world problems so that students can develop the ability to plan, communicate, solve problems and make decisions. Therefore, learning activities are adapted to the characteristics of PjBL which emphasizes important concepts, student-centered learning, realistic projects, constructive investigations, and producing products (Wafula & Ongunya, 2016). The learning objective introduced from project-based learning is so that students are able to design and create work with high creativity (Amini et al., 2019). In the end, it can be concluded that the project-based learning model can develop students' scientific attitudes.

Project-based learning has various advantages. Learning responsibility, achievement of learning goals, independence, and discipline are the results of project-based learning. Project-based learning emphasizes 21st-century skills with students practicing and becoming proficient with communication, negotiation, and collaboration skills. Project-based learning allows students to develop their own interests and pursue deeper learning. The active learning process in project-based learning involves students with various learning styles (Aksela & Haatainen, 2019). Research supports project-based learning as a tool for engaging students in real-world tasks. Real-world projects deepen learning for students (Bell, 2010).

There are several empirical studies that show the success of project-based learning models in learning. Lestari (2021) in his research reported that project-based learning has an influence on critical thinking skills in biology learning outcomes. The results of research by Natalia et al. (2021), show that the project-based learning model can improve student learning outcomes with the average learning outcome for the experimental class being 86.93 while the average learning outcome for the control class is 79.83. In line with research by Hamidah dan Citra (2021), there is an influence of the project-based learning model on student learning outcomes, however, the cognitive domain measured is limited to levels C1 to C4. Despite the popularity of project-based learning, some researchers have doubts about its effectiveness. argue that it is difficult for group members to resolve interpersonal problems during cooperative activities. Project-based learning is a teaching strategy that requires collaboration between students in small groups and its positive effects on student learning depend on the nature of the group composition and the

quality of the group process (Cheng et al., 2008). According to Thomas in Aksela dan Haatainen (2019), research on project-based learning has not had a large enough influence on practice. The results of research by Kristanti and Subiki (2017), the application of the project-based learning model in physics learning in high school does not provide significant results on learning outcomes, according to him this is because students still need to adapt when faced with new learning models, besides that students still experience difficulties in carrying out projects and collecting data even though they are working in groups. Kızkapan and Bektas (2017), also found the same thing there was no significant effect on student learning outcomes from groups that used conventional learning models and groups that used project-based learning models. These studies show inconsistent results regarding the effect of implementing project-based learning models. Inconsistencies in the findings of these studies on the same topic can create uncertainty in the decision-making process (Suyantiningsih et al., 2023).

This inconsistency is related to the general obstacle faced in implementing learning referring to the Integrated Science assessment using a project-based learning model, namely that it takes longer to guide students (Trimawati et al., 2020). This obstacle must be addressed by utilizing and managing time as best as possible during learning. In accordance with research by Fernandes (2014), the implementation of the project-based learning model requires a lot of time and students find it difficult to carry out project activities because students are still used to conventional learning models. In line with the statement of Dewi et al., (2017), project-based learning is learning with long-term activities that involve students in designing, creating, and displaying products to overcome real-world problems. The next weakness is in understanding the syntax of project-based learning, especially the syntax of giving essential questions where the teacher must understand that the product that must be created by students in the learning process must be able to answer the essential questions (problems) that the teacher gives in the initial core activities (Ardiansyah et al., 2020). The habit experienced by participants in classes that apply the project-based learning model is that the teacher always gives direct instructions to students to make a product without providing a problem or essential question that must be solved with the product, this results in students having difficulty finding urgency or the usefulness of the meaning of a product they create during the learning process using a project-based learning model (Nuryadi & Rahmawati, 2018). Titu (2015) added that most real-world problems are inseparable from disciplinary problems, therefore it is recommended to teach by training and facilitating students in dealing with problems. Responding to these problems, to make the effect of implementing the project-based learning model more effective in learning, you can collaborate the model with a learning approach (Allanta & Puspita, 2021).

Based on one of the characteristics of the project-based learning model, namely using problems related to certain material in real situations, socioscientific issues are used as a relevant context for carrying out projects. Students face environmental problems including dilemmas, based on the socioscientific problems presented they discuss and decide to solve this problem by carrying out a project. Therefore, socioscientific issues enrich project-based environmental activities (Şeşen & Mutlu, 2022). Several studies show the influence of the implementation of socioscientific issues in the learning (Fihani *et al*., 2021; Kristiana *et al*., 2020; Utomo *et al*., 2020; Wahdan *et al*., 2017). Moreover, referring to the Merdeka Curriculum with Biology learning outcomes in Phase E, namely that students have the ability to be responsive to global issues and play an active role in providing problem solutions (Kementerian Pendidikan *et al*., 2022). Socioscientific issue-oriented learning is learning that examines facts, phenomena, or events based on social issues related to science in society (Zeidler *et al*., 2009). Socioscientific issues are open-ended, allowing students to think critically about these issues together with other people who have different views (Zeidler & Nichols, 2009). It is believed that the use of socioscientific issues in learning can train students' high-level thinking skills to solve various problems that exist in their daily lives. In its implementation, in order to be able to design learning based on socioscientific issues, teachers must have adequate knowledge of scientific material and the social considerations contained in these issues. Apart from that, teachers need to be aware that in implementing this learning there will definitely be uncertainty in the classroom and there needs to be awareness that the teacher is not the only authority (Rahayu, 2019). This is an obstacle experienced at the planning stage, namely the difficulty of determining the right problem to be able to stimulate a good discussion atmosphere and be able to stimulate students' intellectual development. Based on these obstacles, it can indicate that there is a gap between the theoretical idea of successful implementation of project-based learning models and learning socioscientific issues and the reality of implementing learning in the classroom. The comparison between the theoretical basis and empirical studies where there are still interesting inconsistencies is to be studied again in more depth to perfect the expected learning process.

Based on the results of previous researchers, the author tries to investigate the influence of a socioscientific issue-oriented project-based learning model by paying attention to students' internal factors that influence the success of implementing the learning

model. One of the characteristics of students that can influence the implementation of the project-based learning model is self-efficacy. In project-based learning, students must design, solve problems, make decisions, carry out investigative activities, and work independently with their groups. In order for these stages to run well and smoothly, students need effort and tenacity in the learning process. The higher the self-efficacy, the greater the effort and endurance or tenacity of the students in solving the given problems (Amanda et al., 2014).

Self-efficacy which is students' confidence in their abilities, is very necessary for students to be able to push their abilities to a higher level. This belief in one's own abilities is very important for students to have because to face difficult challenges students must first believe in the abilities they have in order to be able to solve these challenges (Widodo & Kurniawan, 2022). Not only for students, it is very important for teachers to understand this self-efficacy. This is because the school environment and teachers also have a very important role in helping to increase students' self-efficacy (Acai et al., 2022; Rahayu & Osman, 2019). It is important for teachers to help students find out and increase their self-efficacy. Because students' self-efficacy has a positive influence on their learning achievement and science process skills (Zysberg & Schwabsky, 2021). According to Sufiati dan Afifah (2019), Teachers play a very important role in fostering students' interest in learning by using innovative learning methods and creative learning media so that students are enthusiastic and happy to learn. So that students have an idea of how they feel, think, motivate themselves, and behave in solving a problem, this can be done by training their self-efficacy through activities they like (Suyitno, 2017). Therefore, it is very important for teachers to know the level of self-efficacy of their students so that learning outcomes can be achieved optimally. However, in reality, the importance of the role of self-efficacy is not felt by some students (Lestari et al., 2022). Sometimes students think that if they are smart they will always get good grades, and vice versa. Sari et al. (2022), added that student self-efficacy is a very important factor that needs to be considered in learning.

Based on the explanation of the theoretical foundation and learning facts that have been stated above, in this research an investigation was carried out regarding the influence of a project-based learning model oriented towards socioscientific issues on learning outcomes in terms of students' self-efficacy. This research was carried out at SMA Negeri 2 Abiansemal. Based on the results of the initial assessment at SMA Negeri 2 Abiansemal, the Biology learning process is still dominated by the direct learning model. In relation to self-efficacy, information was obtained that teachers know students' character only through their presence and attitude during the learning process, so teachers do not understand the level of students' self-efficacy. Therefore, this research was conducted at SMA Negeri 2 Abiansemal involving class X. The objectives of this research are: 1) describe and explain the differences in learning outcomes of students who use project-based learning models oriented towards socioscientific issues and direct learning; 2) describe and explain differences in student learning outcomes in terms of high self-efficacy using a socioscientific issue-oriented project-based learning model with direct learning; and 3) describe and explain differences in student learning outcomes in terms of low self-efficacy using a socioscientific issue-oriented project-based learning model with direct learning.

Method

This research is a quasi-experimental research with a matching pretest-posttest control group design as in Table 1.

Table 1. Research Design the Matching Pretest-Posttest Control Group Design

Group	Sampling	*Pretest*	Treatment	*Posttest*
Experiment	M	O1	X1	O2
Control	M	O3	X2	O4

Description:

X1	: socioscientific issue-oriented project-based learning model.
X2	: direct learning model
O1	: Pretest learning outcomes in the experimental class
O2	: Posttest learning outcomes in the experimental class
O3	: Pretest learning outcomes in the control class
O4	: Posttest learning results of the control class
M	: matching research sample class

Based on Table 1, the experimental group in the study was given treatment in the form of a pretest, the use of a project-based learning model oriented towards socioscientific issues, and a post-test. The control group was given treatment in the form of a pretest, the use of a direct learning model, and a post-test. The research was conducted at SMAN 2 Abiansemal with a research population of 11 classes, namely class X for the 2022/2023 academic year. The research sample was determined by matching classes, resulting in class X-10 as the control class and X-11 as the experimental class. The research instruments are Pretest and Posttest learning outcomes and a self-efficacy scale. Sorting student self-efficacy based on student self-efficacy scores is ranked with the condition that 50% have high self-

efficacy and 50% have low self-efficacy. Each sample was sorted according to a project-based learning model oriented towards socioscientific issues and a direct learning model.

This research was analyzed using descriptive analysis and two-way analysis of covariance (ANAKOVA). Before testing the hypothesis, an assumption test is carried out in the form of a normality test using the Kolmogorov-Smirnov and Shapiro-Wilk tests, a homogeneity of variance test using Levene's Test of Equality Error Variance statistic and a linearity test using deviation from linearity.

Result and Discussion

Descriptive Analysis

Student self-efficacy data was obtained from the results of the self-efficacy scale filled in by students which consisted of 35 statement items regarding students' self-confidence in studying Biology as in Table 2.

Table 2. Results of Descriptive Analysis of Student Self-Efficacy Data

Statistic	Experiment	Group Control
Mean	69.13	69.43
Std. Deviation	6.945	6.641
Variant	48.237	44.096
Maximum	80.00	80.00
Minimum	57.14	57.14

Based on Table 2 above, we can see the comparison of student self-efficacy between students in the experimental group and students in the control group. Judging from the results of the self-efficacy scale, the self-efficacy value for the group of students in the experimental group ranged from 57.14 to 80.00 with an average of 69.13 and a standard deviation of 6.945. Meanwhile, for the control group students, the students' self-efficacy scores ranged from 57.14 to 80.00 with an average of 69.43 and a standard deviation of 6.641. Based on these data, the self-efficacy of students in the two classes is quite equal based on the average difference between the two class groups which is not too high.

Furthermore, data on student learning outcomes was obtained from the learning outcomes test which consisted of 30 multiple choice questions regarding environmental change material. Table 3 displays a summary of descriptive analysis of learning outcomes data for experimental group and control group students.

Based on Table 3 above, judging from the post-test results, the student learning outcomes scores for the experimental group ranged from 67.00 to 97.00 with an average of 84.85 and a standard deviation of 7.726. In the control group, the post-test scores on student learning outcomes ranged from 47.00 to 93.00 with an average of 72.02 and a standard deviation of 1.123. This illustrates that the learning outcomes of students in the experimental group who studied using a socioscientific issue-oriented project-based learning model were higher when compared to the learning outcomes of students in the control group who studied using a direct learning model.

Table 3. Results of Descriptive Analysis of Pretest and Posttest Data on Learning Results of Control Group and Experimental Group Students

Statistic	Experiment		Group Control	
	Pretest	*Posttest*	*Pretest*	*Posttest*
Mean	55.88	84.85	56.57	72.02
Std. Deviation	7.831	7.726	7.763	1.123
Minimum	43.33	67.00	43.33	47.00
Maximum	70.00	97.00	70.00	93.00

Learning outcomes in terms of high self-efficacy are obtained from sorting the learning outcomes of students who have high self-efficacy in the experimental class and the control class. A summary of the descriptive analysis in Table 4

Table 4. Results of Descriptive Analysis of Pretest and Posttest Data Learning Results of Students with High Self-Efficacy in the Control Group and Experimental Group

Statistic	Experiment Class High Efficacy		Control Class High Efficacy	
	Pretest	*Posttest*	*Pretest*	*Posttest*
Mean	58,63	91,76	58,43	81,96
Std. Deviation	6,461	4,876	8,343	9,133
Variant	41,748	23,775	69,608	83,415
Minimum	46,67	86,67	70,00	93,33
Maximum	70,00	100,00	46,67	63,33

Based on Table 4 above, judging from the Posttest results, the learning outcome scores of students with high self-efficacy in the experimental group ranged from 86.67 to 100.00 with an average of 91.76 and a standard deviation of 4.876. Meanwhile, in the control group, the post-test scores for the learning outcomes of students with high self-efficacy ranged from 63.33 to 93.33 with an average of 81.96 and a standard deviation of 9.133. This illustrates that the learning outcomes of students with high self-efficacy in the experimental group are higher when compared to the learning outcomes of students in the control group.

Furthermore, in terms of low self-efficacy, data on student learning outcomes was obtained by sorting the learning outcomes of students who had low self-efficacy in the experimental class and the control class. A summary of the descriptive test results in Table 5.

Table 5. Results of Descriptive Analysis of Pretest and Posttest Data Learning Results of Students with Low Self-Efficacy in the Control Group and Experimental Group

Statistic	Experiment Class Low Efficacy		Control Class Low Efficacy	
	Pretest	*Posttest*	*Pretest*	*Posttest*
Mean	53.63	79.41	54.71	75.10
Std. Deviation	8.289	5.301	6.878	6.249
Variant	69.709	28.105	47.304	39.052
Minimum	43.33	70.00	43.33	63.33
Maximum	70.00	90.00	66.67	86.67

Based on Table 5 above, judging from the Posttest results, the learning outcomes scores of students with low self-efficacy in the experimental group ranged from 70 to 90 with an average of 79.41 and a standard deviation of 5.301. Meanwhile, in the control group, the post-test scores for the learning outcomes of students with low self-efficacy ranged from 63.33 to 66.33 with an average of 75.10 and a standard deviation of 6.249. This illustrates that the learning outcomes of students with low self-efficacy in the experimental group are higher when compared to the learning outcomes of students in the control group.

Prerequisite Test

Before testing the hypothesis, an assumption test is carried out in the form of a normality test using the Kolmogorov-Smirnov and Shapiro-Wilk tests, a homogeneity of variance test using Levene's Test of Equality Error Variance statistic, and a linearity test using deviation from linearity. A summary of the normality test results is shown in Table 6.

Table 6. Summary of Data Distribution Normality Test

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	dk	Sig.	Statistic	dk	Sig.
Residual	0.063	68	0.200	0.993	68	0.967

Based on the summary of normality test results for data distribution in Table 6, it can be seen that the data significance value is greater than 0.05 for each group for both Kolmogorov-Smirnov and Shapiro-Wilk statistics. So, it can be concluded that the data obtained is normally distributed. Next, a homogeneity test was carried out. A summary of the results of the variance homogeneity test is presented in Table 7.

Table 7. Summary of Variance Homogeneity Test Results

Levene Statistic	df_1	df_2	Sig.
0.593	1	66	0,444

Based on Table 7 above, the results of the variance homogeneity test on the data obtained show that Levine Statistics has a significance figure of 0.444 which is greater than 0.05. This states that the data variance between study groups is homogeneous. The next prerequisite test is the linearity test. A summary of the linearity test is presented in Table 8.

Table 8. Summary of Data Linearity Testing

			F	Sig.
Posttest* Pretest	Between groups	Combination	5.47	0.00
		Linearity	37.74	0.00
		Linearity Deviation In group	0.86	0.54
		Total		

Based on Table 8 above, the linearity deviation shows a significance figure of 0.542 which is greater than 0.05 ($\alpha > 0.05$), which means that the data distribution in each group is linear.

Hypothesis testing

Through the results of data analysis using the two-way ANAKOVA test, results were obtained as presented in Table 9.

Table 9. ANAKOVA Test Result

Source	Type III Sum of Squares	dk	Square Mean	F	Sig.
Corrected model	3750.865[a]	4	937.716	37.314	0.000
Intersection	2793.943	1	2793.943	111.176	0.000
Pretest	1206.163	1	1206.163	47.996	0.000
Learning model	942.574	1	942.574	37.507	0.000
Self-Efficacy	747.932	1	747.932	29.762	0.000
Error	1583.236	63	25.131		
Total	463223.97	68			
Total error	5334.102	67			

The first hypothesis in this research is the null hypothesis which reads "There is no difference in the learning outcomes of students who use the project-based learning model oriented towards socioscientific issues and direct learning", with the alternative hypothesis which reads "There is a difference in the learning outcomes of students who use the project-based learning model socioscientific issue-oriented with direct learning". Based on the results of the two-way ANAKOVA as presented in Table 8, it appears that in the model row the significance value of 0.000 is smaller than 0.05, so it is decided that H_0 is rejected and H_a is accepted. So, it is concluded that there are differences in the learning outcomes of students who use a project-based learning model oriented towards socioscientific issues and direct learning.

Because there are differences, it is continued with the Least Significant Difference (BNt) test or what is known as Least Significant Difference (LSD) to answer the second and third hypotheses. A summary of the results of the LSD follow-up test is shown in Table 10.

Table 10. Summary of LSD further test results

(I) Model* Efficacy	(J) Model* Efficacy	Average Difference (I-J)	Standard Error	Sig.
A_1B_1	A_2B_1	9.693	1.720	0.000
A_1B_2	A_2B_2	5.215	1.724	0.004

The second hypothesis in this research is the null hypothesis which reads "There is no difference in student learning outcomes in terms of high self-efficacy using a socioscientific issue-oriented project-based learning model with direct learning", with an alternative hypothesis which reads "There is a difference in student learning outcomes in terms of from high self-efficacy using a socioscientific issue-oriented project-based learning model with direct learning." Based on the results of the LSD further test as presented in Table 10, it appears that in rows A_1B_1 and A_2B_1, a significance value of 0.000 is obtained, which is smaller than 0.05, so it is decided that H_0 is rejected and H_a is accepted. So, it is concluded that there is a significant difference in student learning outcomes in terms of high self-efficacy who use a socioscientific issue-oriented project-based learning model with direct learning and the average difference between the two groups is 9.693.

The third hypothesis in this research is the null hypothesis which reads "There is no difference in student learning outcomes in terms of low self-efficacy using a socioscientific issue-oriented project-based learning model with direct learning", with an alternative hypothesis which reads "There is a difference in student learning outcomes in terms of from low self-efficacy using a socioscientific issue-oriented project-based learning model with direct learning." Based on the results of the LSD further test as presented in Table 10, it appears that in rows A_1B_2 and A_2B_2, a significance value of 0.004 is obtained, which is smaller than 0.05, so it is decided that H_0 is rejected and H_a is accepted. So, it is concluded that there is a significant difference in student learning outcomes in terms of low self-efficacy who use a socioscientific issue-oriented project-based learning model with direct learning and the average difference between the two groups is 5.215.

There are several theoretical foundations as a basis for justification that the socioscientific issue-oriented project-based learning model provides better results in achieving student learning outcomes compared to the direct learning model. This influence is related to the characteristics of the project-based learning model, which is included in the learning by doing category. The involvement of students in the learning process through project assignments makes the material they receive more meaningful and results in good learning outcomes. The characteristic of the socioscientific issue-oriented project-based learning model is contextual learning where socioscientific issues are used as a relevant context for carrying out projects. According to Mudawamah (2020), through socioscientific issues students can train their argumentation and reasoning skills from various points of view. Students are given the opportunity to evaluate, analyze the impact, and make decisions regarding these socioscientific issues. The socioscientific issue-oriented project-based learning model focuses on students' activities by carrying out in-depth investigations of an issue and looking for relevant solutions that are realized in project work. Students carry out project work in the form of products that are solutions to overcome environmental changes so that students experience a meaningful learning process with their own knowledge. Students are given the opportunity to decide on complete project activities which can guide them to find solutions to the problem so that they can complete the project within the specified time. In addition to planning the completion of project activities, students are also assigned to create a project report which includes project work steps and a description of project results. This can develop students' mindset to construct new knowledge that is linked to existing knowledge by the surrounding environment. This is following the constructivist understanding that knowledge does come from outside but is constructed by and from within a person so that the project-based learning model oriented towards socioscientific issues not only provides knowledge about Biological concepts but also makes this knowledge meaningful through project activities that change the concepts. So far it has been abstracted and become real causing the concept to last a long time in the minds of students. In line with research by Şeşen and Mutlu (2022), that as a different and original point of socioscientific issue-oriented project-based learning model research from other project-based research, namely socioscientific issues are used as a relevant context for carrying out projects. Students are faced with a problem, and based on the socio-scientific problem presented they discuss and decide to solve this problem by carrying out a project. Therefore, socioscientific issues enrich project-based learning activities.

In line with previous research which states that there is a significant difference in student learning outcomes between the experimental class which uses a project-based learning model and the control class, it can be concluded that there is an influence of the project-based learning model on student learning outcomes (Hamidah & Citra, 2021; Natalia et al., 2021; Panjaitan et al., 2019). The direct involvement of students in project

activities can increase students' understanding of the material provided so that the learning outcomes obtained are better. Şeşen and Mutlu, (2022) added that project-based learning activities based on socioscientific issues are good to implement in science programs. Mudawamah (2020), stated that learning socioscientific issues is contextual so that learning is very meaningful. Sadler et al. (2016) found that socioscientific issue-based teaching can promote content learning and improve performance on high-stakes tests so that students can gain statistically significant and practical gains in knowledge. Christenson et al. (2011) concluded that through the use of socioscientific issues in learning, students are able to increase the value of their scientific knowledge which is greater than learning without socioscientific issues. In line with previous research which stated that students who were taught socioscientific issue-based learning showed better learning achievement, analytical thinking, and reasoning (Alqahtani, 2019; Muang, 2010; Wang et al., 2018).

In this research, the results showed that the achievement of learning outcomes of students in terms of high and low self-efficacy who used a socioscientific issue-oriented project-based learning model was higher than that of students in terms of high and low self-efficacy who used a direct learning model. Based on the dimensions of self-efficacy and characteristics, students are said to have high self-efficacy. The first dimension of self-efficacy is the level dimension which is related to the level of task difficulty. Students with high self-efficacy tend to be able to complete tasks with a high level of difficulty because these students feel challenged in completing these tasks. A person is said to have high self-efficacy if the person believes in their abilities and continues to carry out the task given even though the task is difficult (Permana et al., 2016). The generality dimension is the second dimension of self-efficacy which is related to behavior where students feel confident in their abilities. Students with high self-efficacy find it easier to complete their work and can complete various types of work. The third dimension is the strength dimension which is related to the strength of an individual's belief in his abilities. Students with high self-efficacy have strong belief and perseverance in the efforts to be achieved, even though there are difficulties in completing the task, these students will never give up in completing it. Students who have a high level of self-efficacy influence the achievements they achieve, and vice versa. Previous research findings show that self-efficacy is the first step to finding out the extent of one's abilities (Puspitaningtyas, 2017; Widodo & Kurniawan, 2022). In line with research by Yoannita et al. (2016), that for students with high self-efficacy, the increase in learning outcomes achieved is also high.

Relating to the characteristics of the learning model. There are differences in student learning outcomes in terms of high self-efficacy related to the characteristics of the project-based learning model oriented towards socioscientific issues. Project-based learning is student-oriented learning to encourages active exploration. Active exploration activities can of course be carried out through the project learning activity stages. Through project-based learning, students' skills in searching for and obtaining information will increase (Amanda et al., 2014). When working on a task, students who have high self-efficacy tend to choose to be directly involved. In line with Kinskey and Callahan's (2022) research, willingness to engage in action has been found to be associated with high levels of self-efficacy. Socioscientific issue-oriented, socioscientific issues are used as a relevant context for carrying out projects. Students are faced with problems and solve these problems by carrying out a project. Faced with a problem, students who have high self-efficacy because they have greater motivation and do not easily give up in carrying out the tasks given, treat difficult tasks as challenges to be solved.

This is also reinforced by Bandura's (1997) statement that several factors that can influence student efficacy are mastery experiences (experiences in solving problems) and vicarious experiences (experiences gained from other people). The experience of solving problems in working on projects means that each student can express ideas, search for information in their own way about the project being created, discuss with their group friends, and compete with each other to produce products that are different from other groups. In line with research by Amini et al. (2019), students who have high levels of self-efficacy will usually try hard to master their learning tasks. The experience gained from other people in making projects is that students interact with other students so that there is a process of mutual learning and exchanging information between fellow students. In making projects, students also interact with each other, not only exchanging ideas about making projects but also exchanging ideas about concepts or theories in the equipment they use and make. The process of interaction between fellow students and the environment that supports them in the learning process. Support in the learning process has an impact on learning outcomes.

This is supported by research by Amanda et al. (2014) who found that students who followed the project-based learning model and had high self-efficacy had better average science learning outcomes than students who followed the conventional learning model and had high self-efficacy. Socioscientific issue-oriented, Wang et al. (2018) stated that higher scores reveal higher

self-efficacy for issues related to the environment as an impact of discussing socioscientific issues

Considering that each student has a different learning style, project-based learning provides students with the opportunity to explore understanding using various methods that are meaningful to them and carry out experiments collaboratively. Students are free to explore information about their projects through literature review, observation, browsing the internet, and collaborating with teachers. This causes students to learn seriously, thereby enabling each student to ultimately be able to answer the guiding questions. In addition, through discussions with their group friends, students with low self-efficacy are helped in dealing with questions or problems that they cannot solve themselves, students can re-evaluate and formulate their mastery of the material, thereby resulting in maximum achievement of their learning outcomes (Amanda et al., 2014). This statement is in line with Kinskey and Callahan (2022) who state that learning with socioscientific issues is related to knowledge of content or material. Because science content knowledge is a common stimulus for those with low self-efficacy.

Conclusion

Based on the research results and discussion, three research conclusions can be drawn which are answers to the three problems raised in this research. First, it can be concluded that there are differences in student learning outcomes between the group of students who follow the socioscientific issue-oriented project-based learning model and the group of students who follow the direct learning model. Second, there are differences in student learning outcomes in terms of high self-efficacy who use a socioscientific issue-oriented project-based learning model and student learning outcomes in terms of high self-efficacy who use direct learning. Third, there are differences in student learning outcomes in terms of low self-efficacy who use a socioscientific issue-oriented project-based learning model and student learning outcomes in terms of low self-efficacy who use direct learning.

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