



## The Effect of POGIL Model With PAVES-PEPS Strategy to Improve Students' Self-Efficacy and Learning Outcomes in Physics Learning

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### Abstract

Learning outcomes are measures of student results achieved during the learning process. Student learning outcomes are not only influenced by cognitive aspects but also affective aspects, one of which is self-efficacy beliefs. This study aims to determine and describe the effect of applying the POGIL model with the PAVES-PEPS strategy to improve students' self-efficacy beliefs and learning outcomes in physics learning. This study used pre-experimental methods with a One-Group Pretest-Posttest Design research design. The Sample was students of XI MIPA 1 SMA Islam Sidoarjo, selected through the purposive sampling techniques. The instruments used include a self-efficacy questionnaire sheet, questions on learning outcomes, and student response questionnaire sheets to the applied learning model. The results showed a significant difference between students' self-efficacy beliefs and student learning outcomes before and after applying the learning model used. The average value of students' self-efficacy beliefs and learning outcomes has improved. They improved students' self-efficacy beliefs in the medium category and student learning outcomes in the high category. Thus, learning physics using this models affect to improve students' self-efficacy beliefs and learning outcomes.

**Keywords:** Learning Outcomes, PAVES-PEPS, POGIL, Self-Efficacy

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## INTRODUCTION

Education has an essential part in a person's life and development to reach the future, by the goals of education based on the values of Pancasila. Education aims to improve one's devotion to God Almighty, improve intelligence, and skills, strengthen character and personality to build oneself, and be responsible for nation-building (Darmadi, 2019). Education fulfills some of a student's learning needs and determines the quality of their future life. Along with the times, education has its meaning for the life and development of the nation (Cakra Jaya, 2014).

Physics is a branch of fundamental natural science that studies natural symptoms such as matter and phenomena (Darwis, 2018), both microscopic and macroscopic, relating to changes in weight and energy (Alvita & Wasis, 2017). Physics is the main branch of natural science whose principles form the basis for other science departments (Salim & Taib, 2018). Physics has a part in supporting technological advances, one of which is in the world of aviation. Airplanes are the primary means of transportation in the world of aviation. The wings on the airplane have an essential part for airplanes to be able to fly. Wings on airplanes function to produce lift when the airplane moves through the airflow so that it can fly even though it has large dimensions and weight (Hanif et al., 2017).

In basic geometry, an airplane's wings shape an aerofoil cross-section, which produces an aerodynamic effect (Mustak & Ahmed, 2017). Aerodynamics is part of dynamic fluid

science that studies airflow in a moving object (Aynsley, 1999). The function of aerodynamics on airplanes is to regulate aerodynamic devices to regulate the airplane's motion to fly higher or lower. Daniel Bernoulli, a mathematician from Switzerland, explained how the pressure generated from a moving fluid flow could change according to the velocity of the fluid-flow motion (Saputra et al., 2016).

According to Bernoulli's theory, the distance taken by the upper surface on the airplane wings is longer than the lower surface, so the velocity is faster on the upper surface (Babinsky, 2003). The difference in velocity causes the pressure on the upper surface to be smaller, so there will be a lift force on the airplane wings (Pouryoussefi et al., 2016). Bernoulli's theory can be proven by conducting a simple aerofoil experiment, namely making a cross-section of an airplane wing's aerofoil using styrofoam placed in front of a moving air stream, one of which is with a fan. Then can observe the movement of the aerofoil cross-section due to changes in the fan's airflow level.

In delivering the material, the success of student learning in achieving a learning goal indicates that the teacher has succeeded in conveying new material and knowledge to students. Some factors influence student learning success, among others internal factors, including psychological and physiological, and external factors, including social and non-social (Astika et al., 2018). Students' internal factors play an essential part in determining learning success, one of which is self-efficacy (Vishnumolakala et al., 2017).

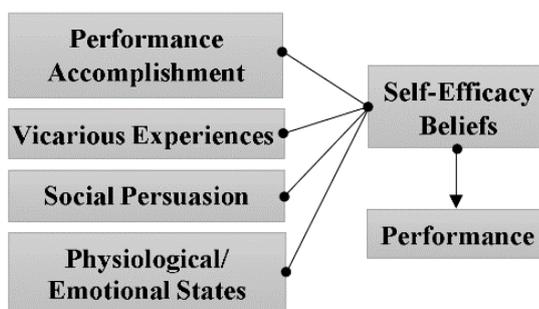
Self-efficacy is a self-belief regarding the ability to succeed in performing tasks, achieving goals, and implementing actions to achieve a specific skill (Hulu & Minauli, 2013). Self-efficacy also determines how a person can achieve goals for a purpose (Kadir, 2018). Self-efficacy in physics subjects is closely related to learning methods, understanding concepts, problem-solving, and student interactions.

According to Bandura's theory, self-efficacy of each individual differs from one individual to another. Bandura's article entitled 'Guide for Constructing Self-Efficacy Scales' explained three aspects of the most accurate dimensions to define a person's self-efficacy: level, strength, and generality (Nurmawaty Sigiro et al., 2017). According to Bandura's theory, self-efficacy can be learned and grown through four sources of components that can influence, among others (1) Performance Accomplishment, (2) Vicarious Experiences, (3) Social Persuasion, and (4) Physiological/Emotional States.

The POGIL (Process Oriented Guided Inquiry Learning) model with the PAVES-PEPS strategy is a learning model with the right strategy to learn and teach dynamic fluid materials quickly. The POGIL combines a guided inquiry model with a cooperative approach (Andriani et al., 2019; Mitchell & Hiatt, 2010) which encourages mastery of concepts, critical thinking skills, problem-solving, communication, and responsibility (Ningsih & Sopyan, 2012). Implementation of the POGIL model by forming small groups with 3-4 students members. POGIL has stages in each cycle, including Orientation, Exploration, Concept formation, and Application (Zumronah et al., 2019). Teachers have an important role as facilitators, monitors, and evaluators of students' learning process with the POGIL model (Barthlow & Watson, 2014).

However, in implementing learning to improve self-efficacy beliefs, it is necessary to pay attention to each process of implementing the learning model used. Improving students' self-efficacy in working in groups can be inhibited by social loafing (Supardi et al., 2021). Social loafing is a person's attitude that reduces motivation and spends less effort when working collectively in groups than individual work (Desta Pratama & Aulia, 2020). In the POGIL model, each student has a different role among group members. These roles include manager, speaker person, recorder, and strategy analyst (Erna et al., 2018). The division of roles helps minimize individual social loafing, and group work becomes more organized.

The PAVES-PEPS (Performance Accomplishment, Vicarious Experiences, Social Persuasion and Physiological/Emotional States) strategy of adapting from four component sources that affect self-efficacy (Bandura & Adams, 1977).



**Figure 1.** Source of Self-Efficacy

Performance Accomplishment is an individual achievement that has been achieved in the past. A person with high-performance accomplishments can face new challenges with optimism and set high goals for individual (Haryati et al., 2020). Vicarious Experiences are experiences by observing other individuals. The similarity of the experience of the same success can improve self-efficacy beliefs (Agustin et al., 2018). Social Persuasion is also very influential in improving individual self-efficacy beliefs. When individuals feel confident verbally that they can solve a problem, they tend to be motivated when the problem comes (Nurfauziah et al., 2018). Physiological/emotional states, anxiety, and stress in individuals usually worsen when work results are unsatisfactory. Low levels of personal anxiety and stress can improve self-efficacy. Conversely, high anxiety and stress levels can lower individual self-efficacy levels (Priyanti et al., 2021).

Dhea (2021) states that learning using the POGIL model is considered effective in improving students' self-efficacy and mastery of concepts (Dhea Neviali et al., 2021). Aiman (2020) also said that the POGIL model could improve student learning outcomes (Aiman, 2020). The problem in this study is the self-efficacy beliefs and learning outcomes of students SMA Islam Sidoarjo in physics learning tend to be moderate to low. The POGIL model with the PAVES-PEPS strategy can help improve students' self-efficacy beliefs so that students feel capable and confident of overcoming obstacles in solving physics problems; it positively impacts student learning outcomes.

Based on the background described, this study aims to determine and describe the effect of the application of the POGIL model with the PAVES-PEPS strategy on improving students' self-efficacy beliefs and learning outcomes in physics learning.

## METHOD

This study used a pre-experimental method, with the research design of was One-Group Pretest-Posttest Design (Knapp, 2016).

**Table 1.** One-Group Pretest-Posttest Design

<i>Pre-test</i>	<i>Treatment</i>	<i>Post-test</i>
O1	X	O2

Information:

O1: Pre-test

X: Treatment of POGIL model with PAVES-PEPS strategi strategy

O2: Post-test

The research population is the students of XI MIPA SMA Islam Sidoarjo in the academic year 2021/2022. The sampling technique is a purposive-sampling technique by taking samples from the population based on specific criteria and considerations. The sample was students of class XI-IPA 1, consisting of 34 students on the school's suggestion considering that students' cognitive abilities were different from one another. Face-to-face learning takes place for four meetings using the POGIL model with the PAVES-PEPS strategy. The implementation of this research is in January 2022.

The research data collection technique gave students self-efficacy questionnaires and test questions about fluid dynamics before and after applying the POGIL learning model with the PAVES-PEPS strategy. The self-efficacy questionnaire adapts three dimensions of self-efficacy, including level, strength, and generality.

The data analysis technique used is a quantitative descriptive technique. This technique describes research data consisting of self-efficacy questionnaires and test sheets about student learning outcomes while applying this models. The research data includes the pre-test post-test scores of students normality tested before the analysis prerequisite test was carried out, processed by statistical processes assisted by IBM SPSS Statistics 25 software.

The results of the students' pre-test post-test scores went through the paired t-test stages. This test determines whether there is a difference between two paired variables (Tae Kyun K, 2015). The hypotheses for the paired t-test include:

Ho: Students' self-efficacy beliefs and student learning outcomes before and after treatment are the same

Ha: Students' self-efficacy beliefs and learning outcomes before and after treatment are not the same

According to the N-gain criteria, the quality of improving students' self-efficacy beliefs and student learning outcomes using normalized N-gain (Hake, 1998).

**Table 2.** Category N-gain

Normalized Gain Range	Category
$N\text{-gain} < 0.30$	Low
$0.70 > N\text{-gain} \geq 0.30$	Medium
$N\text{-gain} \geq 0.70$	High

The research tools and instruments have been tested for validity by three expert lecturers. The results of the validity test of research tools and instruments for applying the POGIL model with the PAVES-PEPS strategy are contained in Table 3.

**Table 3.** Validity Value of Research Instruments and Instruments

Research Instrument	Average Value	Category
Lesson plan	3.86	very valid
Soal Tes	3.67	very valid
Angket <i>Self-Efficacy</i>	3.94	very valid
Angket Respon Siswa	3.9	very valid

## RESULTS AND DISCUSSION

The pre-test post-test data processing of students' self-efficacy beliefs result from a self-efficacy questionnaire in percentages.

**Table 4.** Percentage of Students' Pre-test Post-test Self-Efficacy Score

Interval	<i>Pre</i>		<i>Post</i>		Category
	F	%	F	%	
84%-100%			11	32.4	Very High
69%-83%	8	23.5	20	58.8	High
52%-68%	23	67.7	3	8.8	Medium
35%-51%	3	8.8			Low
20%-34%					Very Low

Based on table 4, the results of the pre-test data analysis before being given treatment illustrate that the student's self-efficacy level is 8.8% in the low category and 67.7% in the medium category. After being given treatment, the results of post-test data analysis showed

an improve in the level of student self-efficacy by 32.4% in the very high self-efficacy category and 58.8% in the high self-efficacy category.

In addition to measuring students' self-efficacy, student learning outcomes are also measured by pre-test and post-test.

**Table 5.** Percentage of Pre-test Post-test Scores of Student Learning Outcomes

Interval	Pre		Post		Category
	F	%	F	%	
81%-100%			22	64.7	Very High
61%-80%			12	35.3	High
41%-60%	25	73.5			Medium
21%-40%	9	26.5			Low
0%-20%					Very Low

Based on table 5, the results of pre-test data analysis before being given treatment illustrate that student learning outcomes are 26.5% in the low category and 73.5% in the medium category. After being given treatment, the student learning outcomes post-test data analysis showed an improve by 64.7% in the very high category and 35.3% in the high category.

The pre-test post-test data analysis must pass the analysis prerequisite test before using the parametric statistical technique with the normality test. The normality test compares the distribution of research data with the standard normal distribution, The normality test results of students' self-efficacy beliefs and learning outcomes.

**Table 6.** Normality Test Results of Pre-test Post-test Self-Efficacy Scores and Student Learning Outcomes

Variable	sig. Pre	Post	Conclusion
Self-Efficacy	0.292	0.124	Normal
Learning Outcomes	0.216	0.148	

The results of the normality test illustrate the Asymp value. Sig (2-tailed) in table 6 > sig. 0.05, then the research data is normally distributed. Thus, it is possible to perform parametric statistical tests, namely the paired t-test.

**Table 7.** Paired T-test Results Pre-test Post-test Self-Efficacy and Student Learning Outcomes

Variable	t	df	Sig. (2-tailed)
Self-Efficacy	-13.416	33	.000
Learning Outcomes	-31.439	33	.000

Based on table 7, Asymp value. Sig (2-tailed) obtained using the paired t-test is 0.000. Thus  $H_0$  is rejected; there is a significant difference between the pre-test and post-test, where the post-test score is significantly greater. In other words, there is an effect of applying this models students' self-efficacy beliefs and learning outcomes.

The N-gain test measures the improvement in students' self-efficacy beliefs and learning outcomes. Table 8 shows the average value of N-gain self-efficacy and learning outcomes.

**Table 8.** Mean N-gain Self-Efficacy and Student Learning Outcomes

Variable	F	N-gain	Category
Self-Efficacy	34	0.40	Medium
Learning Outcomes	34	0.73	High

The mean score of the pre-test students' self-efficacy beliefs was 56.15, while the average value of the post-test was 73.35. The index of improving students' self-efficacy scores shows the medium category; students' self-efficacy beliefs average N-gain value is 0.40.

The mean pre-test score of student learning outcomes was 45.02, while the post-test average was 84.91. The index of improving the value shows the high category, with the average N-gain value is 0.73. Thus, there was an improve in students' self-efficacy beliefs and learning outcomes in physics learning through applying this models.

The POGIL model tends to influence improving student learning outcomes in physics learning positively. Students actively collaborate with groups and are responsible for the investigation process with their respective roles so that learning runs more effectively. In the learning process, students conduct simple aerofoil experiments which aim to help students understand dynamic fluid material, especially airplanes lift and aerodynamics, by experimental means. In addition, the existence of a simple aerofoil experiment can prove students' hypotheses regarding Bernoulli's theory. With students directly involved in the discovery of concepts to the application of material during the learning process, it can improve students' understanding so that it helps in optimizing the improvement of learning outcomes. The improvement in student learning outcomes on high category supports this statement.

The PAVES-PEPS strategy can help optimize a person's self-efficacy beliefs. Students with exemplary performance accomplishments will have high self-efficacy.

<p>Type Here!</p> <p>Alhamdulillah, there have been many moments that are enough to make me proud. But one of the things I am most proud of is when I won a district-level poetry reading competition in middle school.</p>
<p>Type Here!</p> <p>The proudest thing in my life is when I can do complicated math/physics problems independently without looking at the internet. Another thing that I am proud of is when I can get in the top 3 in the class, so my parents feel happy. Also, when I got the second-highest score on the try-out of all the 9th graders in my school. Even though it's just a try-out, I work hard on these questions.</p>

**Figure 2.** Student Performance Accomplishment

Students tell about their past achievements and proud experiences in the learning process. Figure 2 shows a sample of students with exemplary performance achievements. After conducting the post-test self-efficacy questionnaire, both samples of students experienced an improve in their level of self-efficacy belief. Telling the experience of success in doing a task can improve students' self-efficacy beliefs.

In the vicarious experiences process, students read literature about the life stories of inspirational figures Daniel Bernoulli and B.J Habibie related to learning materials, namely dynamic fluids about airplanes and aerodynamics. Through a student response questionnaire, 82.35% stated that they strongly agree that the literature on the vicarious experience can inspire and serve as role models for students. The vicarious experiences literature is also a factor in improving students' self-efficacy beliefs.

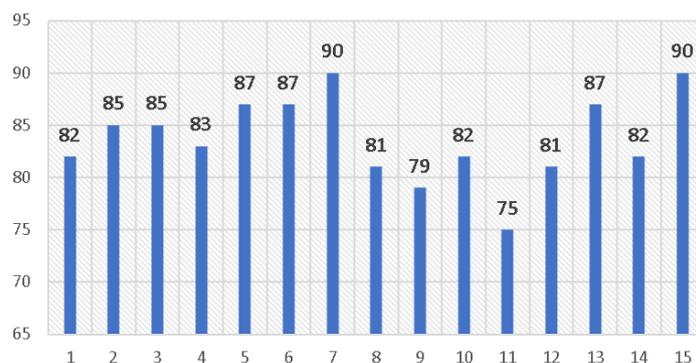
In the Social Persuasion process, students become more confident that they can complete the given task after getting directions in the form of advice and suggestions from all class components, especially from teachers. Persuasion from teachers will have a more substantial influence because teachers have a reputation, experience, and expertise in their field. The quote from the book 'A Teacher Is a Many Things' explains that one of the characteristics of teachers is a professional authority holder in the classroom (Pullias &

Young, 1977). The persuasive authority will have the power to influence and dominate so that the compelling message is embedded. The teacher's role is to motivate and provide direction for students to carry out investigations and find concepts to guide solving problems using previous concept findings during learning using the POGIL model to help optimize students' self-efficacy beliefs.

In Physiological/Emotional States, physical and mental conditions can reduce a person's performance. Intense anxiety and high-stress levels in learning can reduce students' self-efficacy. The efforts to overcome students' anxiety and stress in the learning process include: (1) creating a fun class, (2) developing a 'sense of humor' for teachers and students, (3) using a humanistic approach to classroom management (Rudiansyah et al., 2016). POGIL is a student-centered learning model, helping students express themselves and have an active role during the learning process, creating a pleasant classroom atmosphere to minimize students' anxiety and stress levels in learning. Optimizing pauses during the learning process using the POGIL model with humor or making jokes makes the class atmosphere more relaxed but still based on ethics and not cornering certain parties. In addition, building close, tolerant relationships and avoiding negative reinforcement during learning with the POGIL model also helps minimize students' anxiety and stress levels.

Thus, learning physics using the POGIL model with the PAVES-PEPS strategy successfully optimized the improvement in self-efficacy beliefs and student learning outcomes. Risnawita (2017) supports this research, showing that the source scale of self-efficacy can be explained and grown through a combination of four components that affect self-efficacy: Performance Accomplishment, Vicarious Experiences, Social Persuasion, and Physiological/Emotional States (Risnawita, 2017). Alamanda's (2015) research shows that classically students' self-efficacy beliefs and learning outcomes improve after the POGIL model is applied (Alamanda & Novita, 2015).

#### Presentation of Student Responses



**Figure 3.** Percentage of Student Response Results to Physics Learning Using the POGIL Model with the PAVES-PEPS Strategy

Based on the student response questionnaire results, the average percentage was 84.07% in the very good category. The highest rate of student responses to the statement that learning physics using the POGIL model with the PAVES-PEPS strategy is considered effective in helping students understand the material. In addition, the existence of group discussions with the role players of each group member makes it easier to solve problems on the given task.

#### CONCLUSION

Based on the study results, there was an improve in students' self-efficacy beliefs and learning outcomes after applying the POGIL model with the PAVES-PEPS strategy in physics learning. They improved students' self-efficacy beliefs in the medium category and student learning outcomes in the high category. Paired t-test showed a significant difference between self-efficacy and student learning outcomes before and after this models was applied

to physics learning with a significantly higher post-test score. Thus, learning physics using this models affect to improve students' self-efficacy beliefs and learning outcomes.

## RECOMMENDATION

Self-efficacy is one of the factors that can affect student learning outcomes. Self-efficacy can improve if students believe in their abilities and the results that will be obtained for their hard work. This is suggested for other researchers in choosing the right learning model and strategy. The POGIL model with the PAVES-PEPS strategy is expected to be widely applied in learning as an alternative to improve self-efficacy and student learning outcomes.

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