



The Impact of *MERDEKA* Path-Based Project Based Learning Model on Self-Efficacy in Primary School Mathematics Learning

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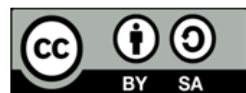
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ABSTRAK

Merdeka Belajar saat ini menjadi tujuan utama dalam proses pembelajaran yang dilatarbelakangi oleh kebutuhan siswa. Tidak hanya karakter, siswa juga perlu memiliki soft skills untuk menghadapi tantangan di abad ke-21. Self-efficacy menjadi penting agar siswa memiliki keyakinan dan tekad untuk melakukan sesuatu, sehingga proses pembelajaran menjadi efektif dan berdampak baik pada hasil belajarnya. Penelitian ini bertujuan untuk menganalisis pengaruh implementasi model PjBL berbasis *MERDEKA* path terhadap self-efficacy pada mata pelajaran matematika. Jenis penelitian ini menggunakan quasi-eksperimen dengan desain one group pretest-posttest design, dengan jumlah 22 siswa kelas IV sebagai sampel jenuh. Instrumen penelitian yang digunakan berupa angket self-efficacy dan tes. Analisis data dilakukan dengan teknik analisis deskriptif dan uji Paired Sample t-Test. Sebelum uji hipotesis dilakukan, dilakukan uji prasyarat yang mencakup uji normalitas dan uji homogenitas. Hasil penelitian menunjukkan bahwa implementasi model PjBL berbasis *MERDEKA* path dapat meningkatkan self-efficacy siswa dibandingkan sebelum diberi perlakuan. Hal ini terlihat dari kenaikan nilai rata-rata siswa sebelum perlakuan yaitu 62,09, meningkat menjadi 79,31 setelah penerapan model PjBL berbasis Alur *MERDEKA*. Hasil uji t menunjukkan $t_{hitung} \geq t_{tabel}$ ($17,422 > 2,05954$), yang mengindikasikan bahwa H_0 ditolak dan H_1 diterima. Dengan demikian, dapat disimpulkan bahwa terdapat pengaruh positif dari model pembelajaran PjBL berbasis *MERDEKA* path terhadap self-efficacy siswa kelas IV sekolah dasar.

ABSTRACT

Merdeka Belajar is currently a primary goal in the learning process, driven by students' needs. Not only character, but students must also possess soft skills to face the challenges of the 21st century. Self-efficacy is important for students to have confidence and determination in performing tasks, making the learning process effective and positively impacting their learning outcomes. This study aims to analyze the impact of the *MERDEKA* path-based Project-based Learning (PjBL) model on self-efficacy in mathematics. This study employs a quasi-experimental design with a one-group pretest-posttest design, involving 22 students from the fourth grade as a saturated sample. The research instruments include a self-efficacy questionnaire and a test. Data analysis was conducted using descriptive analysis and Paired Sample t-Test. Prior to hypothesis testing, prerequisite tests including normality and homogeneity tests were performed. The results indicate that the implementation of the *MERDEKA* path-based PjBL model can improve students' self-efficacy compared to before the treatment. This is evident from the increase in the average score of students, from 62.09 before the treatment to 79.31 after the implementation of the *MERDEKA* path-based PjBL model. The t-test results show $t_{count} \geq t_{table}$ ($17.422 > 2.05954$), indicating that H_0 is rejected and H_1 is accepted. Therefore, it can be concluded that the *MERDEKA* path-based PjBL model has a positive impact on students' self-efficacy in fourth-grade primary school mathematics.

1. INTRODUCTION

Education in the 21st century has 4 competencies or what are usually called 4Cs that students must have, namely critical thinking and problem solving (thinking critically and solving problems), creativity (creativity), communication skills (ability to communicate), and the ability to work collaboratively (ability

to cooperate) (Alismail, 2023; Mentis & Iskender, 2021; Thornhill-miller et al., 2023). To improve each of these competencies, schools, especially teachers, have several choices of learning activities that can improve these competencies, one of which is SIDH (Indonesian School of the Hague) which has various strategies for improving 4C competencies. (Mentis & Iskender, 2021; Partono et al., 2021). *Merdeka Belajar* contains several educational policy decisions which are solutions to improve the condition of Indonesian education (Margaret, 2023; Pangestu & Rochmat, 2021). The principles for developing operational curricula in educational units, especially at the elementary school level in the independent curriculum (Charli et al., 2020; Sumandya et al., 2022; Sundawa et al., 2021). Strategies for improving student competencies such as 4C competencies can be obtained through classroom learning activities. By providing learning that is oriented towards student activity, it is hoped that students' 4C competencies can increase (Monica et al., 2019; Yamin & Syahrir, 2020). Student center learning provides opportunities for students to carry out certain activities so that student independence can be trained. Factors that influence student independence can come from within and outside the student (G. O. Anggraini & Wiryanto, 2022; Pangestu & Rochmat, 2021). Factors that originate from within students include psychological factors such as independence, self-efficacy, learning motivation, attitudes, interests and study habits. Factors that come from outside students usually include the natural environment, socio-economic factors, teachers, teaching methods, curriculum, subjects, and facilities and infrastructure (Niemi & Niu, 2021; Pane & Dasopang, 2017). Apart from that, one of the most important factors for successful learning is student independence.

One of the learning independence factors mentioned above is self-efficacy. Self-efficacy is belief and hope in a person's ability to complete a task. According to Bandura, self-efficacy is a person's belief in his ability to obtain the desired results (Kensicki et al., 2022; Rindu et al., 2021). Self-efficacy is also related to how much students believe that with their abilities they can successfully do or complete various school assignments. Students with high self-efficacy have higher efforts when doing school assignments, believing they can successfully do the assignment (M. A. Samsudin et al., 2020; Svartdal et al., 2020; Ziegler & Opdenakker, 2018), and don't give up easily. Based on this, this research examines students' self-efficacy, especially in mathematics subjects. Self-efficacy is the strongest determining factor in human efforts and achievements in working in future life as well as stability and strategic activities. Beliefs in self-efficacy help determine how much effort individuals will expend in an activity, how long they will persist when faced with obstacles, and how resilient they will be in the face of adverse situations. (Keşan & Kaya, 2018; Niemi & Niu, 2021). Self-efficacy can also influence motivation, persistence in overcoming task difficulties, and efficiency. Self-efficacy influences students' choice of activities, with low self-efficacy in learning may avoid many learning tasks, especially difficult tasks. Students with high self-efficacy usually face learning tasks with enthusiasm. Individuals with low self-efficacy feel less confident to complete a task and therefore try to avoid the task. Active learning that teachers can implement in the classroom varies. Teachers have many alternative choices in determining the learning components that will be used by combining approaches, models, methods and learning techniques that are deemed appropriate to students' learning needs (Semilarski et al., 2021; Ting et al., 2022). In implementing the project-based learning device design strategy, it is very in accordance with the current curriculum. Then this learning can increase students' self-confidence and learning outcomes in class (Saputra et al., 2020; Sulthon et al., 2021). By having teachers who are independent in teaching, a pleasant learning atmosphere can be created, giving students space to be creative and collaborate to gain self-confidence (Bahar & Sundi, 2020; Yamin & Syahrir, 2020).

However, based on the results of observations made in class IV at SD Negeri Golo, teachers are used to providing conventional learning which prioritizes the lecture method. This makes students' opportunities to express opinions limited and more focused on the teacher's delivery alone and makes learning teacher-centered. Occasionally in group activities, each group only has one student who dares to express an opinion and the rest only rely on the group's assessment on the students who have presented. Apart from that, students' learning achievement, especially in mathematics in corner material, only reached a class average of 62.8 with 69% of the students in the class not yet reaching the KKM score. This certainly hampers learning activities because students cannot determine their interest in learning, confidence in carrying out assignments both individually and in groups. The implementation of the independent curriculum currently in use is also not optimal because teachers have not maximized problem-based and project-based learning. This is in line with research conducted by Fernando that students with high self-efficacy have greater academic expectations and show better academic performance compared to those with low self-efficacy (Darmawan et al., 2019; Doménech-Betoret et al., 2017).

Students in elementary school basically do not have a good level of self-confidence. This causes low self-efficacy, especially in exact subjects. The self-efficacy of students at the elementary school level in dealing with mathematics story problems shows that learning strategies have a strong influence in increasing self-efficacy (Hasanah et al., 2019; Mahmood et al., 2021). The self-efficacy variable is built by several indicators, including being able to overcome difficulties, perseverance and the student's own confidence. Low self-efficacy can be one of the drivers of cheating behavior in students (Anitasari et al.,

2021; Hendriana et al., 2017). Looking at several studies that have been conducted regarding self-efficacy in students, it can be seen that self-efficacy is very important for students. In this case, the teacher's role is necessary to help students so that they have good self-efficacy. Teachers need to pay attention and can be improved through the learning process designed by the teacher. By providing correct treatment in the learning process in class, students' self-efficacy is expected to be able to develop and have an impact on students, especially in honing their abilities to become more confident (Agus, 2021; Ahdhianto et al., 2020).

One learning model that has various activities and involves students is the PjBL model. By implementing and compiling learning tools, the use of PjBL can increase students' self-efficacy (A. Samsudin & Liliawati, 2022). The PjBL model is an instructional design pattern that can provide creative learning that is student-centered and uses teachers as motivators and facilitators, as well as providing opportunities for students to work independently in constructing their knowledge. (P. D. Anggraini & Wulandari, 2020; Kusadi et al., 2020; Mustika & Ain, 2020). In line with this, the PjBL model is a model that emphasizes student-centered learning in a project and allows students to achieve their own learning and can produce work in the form of writing, images, videos and so on. (Ratna et al., 2019; Yani & Taufik, 2020). In it there are activities that must create meaningful work through activities that encourage students to show creativity and problem solving (Beatson et al., 2018; Sahtoni et al., 2017) and can well help students improve their learning outcomes. Based on the explanations above, it can be seen that the PjBL model is a learning model that can provide innovative learning that is student-centered in a project and allows students to achieve their own learning and produce certain works that can encourage students to show creativity.

Learning activities in mathematics, the PjBL model allows students to interact through the exchange of ideas to encourage a collaborative attitude (Asmi et al., 2022; Marianti & Rahayuningsih, 2022; Ralph, 2016). So it can be seen that there are good results and responses from students, the results of learning and learning activities are known as learning outcomes. In the independent curriculum currently being used, there is a learning concept that seeks students to recognize their own abilities, interact in groups and collaborate. One of the concepts applied is the Merdeka Belajar flow which is implemented in the *Merdeka* Curriculum (Diren Agasi & Desyandri, 2022; Setiawan & Martin, 2023). This concept is oriented towards project-based learning. The stages in the *MERDEKA* pathway are, Starting from yourself, Concept exploration, Collaboration space, Contextual demonstration, Elaboration of understanding, Contextual demonstration and Real action. Transformative learning can be encouraged through the flow and structure of communication, collaboration, and individual thought processes in an online learning ecosystem that involves reflection and dialogue. Apart from reviewing theory and involving students in the learning process, this learning also provides information and motivation for students to learn and transfer understanding in real life (Kumar & Nanda, 2019; Pangestu & Rochmat, 2021).

In general, previous research has not discussed the implementation of the *MERDEKA* flow-based PjBL model. Where the learning process uses the PjBL model and is assisted by the *MERDEKA* flow. Judging from the importance of efforts to grow self-efficacy in students, activities in the *MERDEKA* stream can be one way to help teachers grow and even increase self-efficacy in students. With the Starting from Self activity, it is hoped that students will be able to find out what knowledge they already have, and can put it into discussion activities and presentations facilitated by the teacher in the learning process. If students' self-efficacy has been built, it is hoped that there will be an increase in their learning achievement. Because currently the learning outcomes of class IV students, especially in mathematics, are still below minimum competency. Based on the problems that occur, the aim of this research is to analyze the implementation of the learning process using the *MERDEKA* flow-based PjBL model which is related to self-efficacy in fourth grade students, especially at SDN Golo, Yogyakarta.

2. METHOD

In the 2022/2023 school year, this research was carried out at SD Negeri Golo, Yogyakarta, in class IV. All fourth-grade students were included in this research sample using nonprobability sampling techniques. This technique is used using saturated sampling with sampling that draws samples from the entire population. In this study, non-probability sampling methodology was used. A total of 22 students were sampled in this research. The type of quantitative research used in this research. The method used is an experimental method involving one class. This research uses an experiment with a one group pretest-posttest design. One group pretest-posttest design is a technique to determine the effect of activities before and after giving treatment (Sugiyono, 2019). So, the design of this research is presented in Table 1.

Table 1. Research Design Scheme

Class	Pre-test	Treatment	Post-test
Experiment	O ₁	X	O ₂

This research consists of the independent variable (X), namely learning with the *MERDEKA* Alur-based PjBL model and the dependent variable (Y), namely self-efficacy. The instruments used to collect data were self-efficacy questionnaires and tests. This questionnaire is used to identify the initial self-efficacy that students have in the classroom when learning mathematics. This instrument is a non-test instrument that is given at the beginning of learning before taking action and after taking action. Before carrying out treatment, 3 meetings were held for observation with the class teacher to observe self-efficacy, especially in mathematics subjects. Students are also given tests to determine cognitive learning outcomes before action and after action in the form of essay questions. After that, students were given treatment using learning tools by applying the PjBL model based on *MERDEKA* path for 3 meetings. In order to get an idea of how self-efficacy exists in fourth grade students at SD Negeri Golo, a questionnaire sheet was used with several assessment aspects, including ability to overcome task difficulties, confidence in resolving difficulties and perseverance in completing things (Hendriana et al., 2017). Self-efficacy assessment uses a 1-4 Likert scale. The self-efficacy instruments is presented in Table 2.

Table 2. Self-Efficacy Questionnaire Instrument Table

No	Dimensions	Indicator	Amount
1	Magnitude	Look optimistically in studies and work.	3
		How much interest you have in lessons and assignments.	3
		Feel confident you can do and complete the task.	3
		View difficult tasks as a challenge.	6
		Act selectively in achieving goals.	2
2	Strength	Commitment to completing assigned tasks.	2
		Believe and know the advantages you have.	1
		Persistence in completing tasks.	3
		Has good motivation towards himself.	2
3	Generality	Respond well to different situations and think positively.	1
		Make the experience to increase confidence in achieving success.	1
		Can handle all situations effectively.	1
		Try a new challenge.	2

The data analysis technique in this research uses descriptive analysis techniques and inferential analysis techniques with the t test. Inferential analysis is used to evaluate research hypotheses, while descriptive analysis is used to summarize the data that has been collected. Before testing the hypothesis, a prerequisite test is carried out consisting of a homogeneity test and a normality test.

3. RESULT AND DISCUSSION

Result

Research data in the form of student self-efficacy scores were analyzed using inferential statistics. Hypothesis testing begins with analysis prerequisite tests, namely the normality test and homogeneity test. The normality test is used to determine whether the data collected is normally distributed or not. The criteria used are that it is declared normal if the significance or coefficient value (P-value) on the One Sample Kolmogorov-Smirnov output is greater than the specified alpha, namely 0.05. The results of the normality test show that the self-efficacy data before and after treatment is normally distributed. The test results are presented in Table 3.

Table 3. Normality Test Results

Group	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest	0.146	22	0.200	0.957	22	0.434
Post-test	0.116	22	0.200	0.972	22	0.760

The homogeneity test is used to determine whether several data population variants are the same or not. The criterion for homogeneity testing is that if the significance value is greater than 0.05, it can be said that the variance of the two existing data is the same. The results of the homogeneity of variance test show that the data analyzed in this study is homogeneous. The test results are presented in Table 4.

Table 4. Results of the Homogeneity of Variance Test

Statistics Parameter		Levene Statistic	df1	df2	Sig.
Self-efficacy	Based on Mean	0.934	1	42	0.339
	Based on Median	0.987	1	42	0.326
	Based on Median and with adjusted df	0.987	1	40.637	0.326
	Based on trimmed mean	0.948	1	42	0.336

Hypothesis testing in this research uses the t-test. Based on the previous prerequisite test, namely that the data is proven to be normally distributed and homogeneous, the next step is hypothesis testing/t-test which is carried out to determine whether the proposed hypothesis can be accepted or rejected. Hypothesis test results can be seen in Table 5.

Table 5. Paired Sample t-Test

Paired Group	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 Pretest - Posttest	- 25.909	6.976	1.487	-29.002	-22.816	-17.422	21	0.000

Table 5 shows that the tcount value is -17.442, this tcount is negative because the average value before treatment is lower than after treatment, which means that a negative tcount value means positive. As for the sig value. (2-tailed) 0.000 < 0.05. Based on the value of tcount 17.422 > ttable 2.05954. shows that H0 is rejected and H1 is accepted so that there is an influence of the use of the MERDEKA flow-based PjBL learning model on self-efficacy in class IV students. Recapitulation of student assessment data is show in Table 6.

Table 6. Recapitulation of Student Assessment Data

Types of Learning	The number of students	Average value	Std Deviation	Minimum Value	Maximum Value
Lectures and Questions and Answers	22	62.09	20.85	30	90
MERDEKA Flow Based PjBL	22	79.32	11.88	60	100

Table 6 shows that the results of the tests carried out by students show changes in scores on the pre-test and post-test. Before the action was carried out the average class score was 62.09 and after the treatment the class average was 79.32. Before the learning process was carried out using the independent flow-based PjBL model, students carried out conventional learning, namely in the form of learning using the lecture and question and answer method between the teacher and students where grades were taken as an initial assessment. So it can be concluded that the implementation of the PjBL model based on the MERDEKA pathway in class IV of SD Negeri Golo has increased.

Discussion

Self-efficacy is an important thing for students to act based on learning experiences to achieve good goals (Zysberg & Schwabsky, 2021). Initial observation results show that students' self-efficacy is less than optimal which influences their learning outcomes, so a solution is needed to provide facilities to students in the learning process. In accordance with the demands of the 21st century and the goals of the Independent Curriculum, students are designed to be the center of learning (Isa & Kamin, 2019; Kusuma et al., 2023). The use of a project-based learning model, namely the PjBL model, provides student-centered activities

(Dewi Handayani et al., 2021; Lusiana et al., 2022), so this activity is still considered effective in increasing students' self-efficacy (Gothberg et al., 2019; Mahasneh & Alwan, 2018; Shin, 2018). The process carried out at the teaching and learning stage starts with questions and answers and students are assessed as being able to express opinions and follow the teacher's directions appropriately. The teaching and learning stages focus more on students. Students begin learning by conveying previously held knowledge through questions and answers. Next, in the Concept Exploration stage, students read the information contained in the LKPD that has been given by the teacher (Desrianti & Yuliana Nelisma, 2022; Simbolon & Koeswanti, 2020). At the Collaboration and Demonstration stage, students learn in groups.

The results of the research that has been carried out show that collaboration in learning using the *MERDEKA* Alur-based PjBL model can increase student self-efficacy and learning outcomes. The important things in self-efficacy are the ability to overcome task difficulties, confidence in resolving difficulties and perseverance in completing things. These three indicators can be improved through activities in the PjBL and *MERDEKA* path models. Students' self-efficacy can be seen from their perseverance and self-confidence (Niemi & Niu, 2021; Toharudin et al., 2019), so that they can act based on their own awareness (Abdi, 2023; Hendriana et al., 2017). When students have high self-efficacy, they feel they will be successful in completing their assignments (M. A. Samsudin et al., 2020; Ziegler & Opdenakker, 2018). The activities in the PjBL and *MERDEKA* path models are important for students because with collaboration they can practice working together for the common good. Students who do not have the confidence to complete assignments and feel that the assignment is important and must be completed. The stages in the PjBL model syntax and *MERDEKA* Flow provide opportunities for students to convey the results of their group performance through presentations as a basis for developing learning outcomes (Shin, 2018; Yusron & Sudiyatno, 2021). Students who had the desire to present and convey the results of group discussions were initially limited to one student in each group, but after the implementation of the Alur *MERDEKA*-based PjBL model, students who felt confident in speaking up and expressing their opinions increased. In the teaching and learning process using the PjBL model based on Alur *MERDEKA*, these learning activities play a very important role in honing students' self-efficacy skills. (Darmawan et al., 2019; Hendriana et al., 2017).

The results of the research that has been carried out show that there is a relationship between increased self-efficacy and increased learning outcomes (Ningrum & Rahmawati, 2021; Wangid & Purwanti, 2020). Apart from that, using the PjBL model based on *MERDEKA* path can help students work together in groups so they can develop their thinking (Sagung et al., 2020) and can increase student creativity (Surya et al., 2018; Viro et al., 2020). So it cannot be denied that the PjBL model based on *MERDEKA* path can increase self-efficacy in students which also has an impact on improving student learning outcomes. Difficult tasks tend to be avoided by students who have low self-efficacy (Fuller et al., 2018; Toharudin et al., 2019), so that the desire to complete assignments is also low and ultimately learning outcomes are not optimal. Implementation of the PjBL model has also been proven to be able to develop students' self-efficacy abilities in all stages (Ferrero et al., 2021; A. Samsudin & Liliawati, 2022; Shin, 2018). The ability of self-efficacy is related to awareness of one's own beliefs or readiness (Hasanah et al., 2019; Kurniawati et al., 2022). Self-efficacy abilities have a better chance of being successful if classroom learning uses the PjBL learning model based on Alur *Merdeka*.

The PjBL model is a model that focuses on activeness, student involvement in creating a project in the form of a product in learning activities (Keşan & Kaya, 2018; Lestari & Juanda, 2019; Rati et al., 2017). Interactive learning helps students understand lessons more easily by exploring and finding out for themselves (Beatson et al., 2018). The PjBL model helps students interpret learning outcomes in depth and stimulates students to have self-efficacy abilities (Allanta & Puspita, 2021; Ismail et al., 2021). Self-efficacy increases if teaching activates students' personal knowledge construction toward understanding, and if the learning environment is mastery-oriented, challenging, and caring.

The strength of this research lies in the use of the *MERDEKA* path to support the PjBL model by considering the use of the new curriculum in grade IV. Learning with the *MERDEKA* path provides students with the opportunity to explore the information they have learned previously at the Starting from Self stage. Next, students are given knowledge in the form of concepts, then discussion activities are carried out at the Collaboration Room stage. The results of the discussions that have been carried out are submitted to the teacher to provide input and suggestions in the Contextual Demonstration stage. After providing a stimulus with questions and answers, providing contextual knowledge information, discussing and making projects, students are presented with knowledge about angle material in another form, namely video. This stage is named Elaboration of Understanding. After students have new information, the teacher and students discuss how to relate corner material to its benefits in everyday life at the Connection between Materials stage. The final stage is Real Action, in this stage students are guided by the teacher to present the results of discussions and projects they have created and give students the opportunity to comment and provide input on the work of other groups. However, this research still has shortcomings and limitations, such as the limited number of samples used, the implementation time being cut short by other subjects and the

large number of learning media used. Therefore, it is hoped that future research can use more samples, estimate learning time more carefully and prepare more practical learning tools. So, in the future educators can use the PjBL model based on *MERDEKA* path in other subjects and maximize it in the learning process in order to increase students' self-efficacy, especially in mathematics subjects.

4. CONCLUSION

The use of the PjBL model based on *MERDEKA* path can increase the self-efficacy of fourth grade students in mathematics subjects with corner material so that it also influences student learning outcomes. There was a significant change in students' self-efficacy before and after treatment. So, the PjBL model with the concept of Alur *MERDEKA*, if applied simultaneously, can be an alternative for overcoming self-efficacy problems that exist in students, especially in mathematics lessons.

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