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Primary teachers' readiness to use project: investigate teachers' efficacy and attitude toward project-based learning

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ABSTRACT

The purpose of our study was to investigate primary teachers' readiness to use project-based learning (PBL) using teachers' efficacy and teachers' attitude toward PBL. A correlational descriptive design was set as the research design on 109 primary teachers from various schools who had participated in collaborative work projects in 2023. To collect data, teachers' efficacy and teachers' attitude scale were used as instrument. The results found that the level of use of PBL was influenced by teachers' attitude toward PBL for each subscale except on the knowledge dependence and system restriction. The study also found that the level of use of PBL has a positive relationship with each subscale of teachers' efficacy and the level of teachers' efficacy is influenced by teachers' attitude toward PBL for each subscale, except for the knowledge dependence. Implications of this study are expected to be considerations for professional development that focus on more concrete practical training.

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1. INTRODUCTION

Project-based learning (PBL) is an instructional approach that has gained recognition worldwide for its effectiveness in promoting active learning, critical thinking, and problem-solving skills among students [1]. By engaging students in real-world projects, PBL encourages them to investigate, create, and present solutions to authentic problems, resulting in a deeper understanding of the subject matter [2]. Project-based learning challenges students to think critically, analyze information, and develop problem-solving skills as they work on complex, authentic projects [3]. They learn to apply their knowledge and creativity to find innovative solutions.

In the context of Indonesian primary education, the integration of innovative teaching methodologies (such as PBL) has become increasingly important. As a country with a strong focus on education as a driver of social and economic development, Indonesia recognizes the need to foster students' critical and creative thinking skills to meet the demands of the 21st century [4]. Therefore, understanding the readiness faced by primary teachers in implementing PBL is crucial in advancing educational practices and enhancing student learning outcomes.

Although several literature sources have suggested teachers to teach using PBL [5], it is still found that some teachers use traditional approach. Before adopting the new approach, teachers encounter a variety of obstacles that must be surmounted, extending beyond a specific instructional method. The instructional method categorizes these barriers into three clusters: technical, political, and cultural [6]. Technical barriers involve teachers' existing reliance on textbooks, assessment challenges, and difficulties in managing group work. Political barriers pertain to resistance from parents, unresolved conflicts among teachers, and resource limitations. Cultural barriers are associated with teachers' beliefs, values, and dedication to preparing students for the next educational level. Several researchers emphasize the importance of teacher beliefs in implementing new methods in the classroom [7]. Furthermore, professional development should target these beliefs as one of its goals [8].

Teaching experience is related to success in implementing PBL as a new teaching approach, particularly in the ability to manage projects and result achieved [9]. Level of teachers' experience is one of the predictors for teachers in selecting the learning approach (traditional or PBL approach) because it relates to teachers' beliefs [10]. Teacher beliefs refer to the individual thoughts and attitudes that teachers hold about various aspects of teaching and learning. These beliefs are shaped by teachers' experiences, training, cultural background, and personal philosophy of education.

The analysis of teacher beliefs can be captured from teachers' sense of efficacy because both are related to psychological constructs that influence the mindset and actions of individuals in their professional role [11]. Teachers' efficacy refers to teachers' beliefs in their ability to positively influence student learning and behavior [12]. It is the confidence and belief that teachers have in their instructional capabilities to promote student growth and success. Teachers with high levels of efficacy believe they can effectively manage student engagement, classroom management, and instructional strategies [13].

2. LITERATURE REVIEW

2.1. Project-based learning

Project-based learning is an educational approach that focuses on students engaging in real-world, complex problem-solving activities. PBL is often equated with inquiry learning, problem-based learning and experiential learning. The similarity lies in the specific context, learners are actively involved in the learning process, and achieve learning objectives through the interaction process of sharing knowledge and understanding [1]. PBL is different from inquiry learning because PBL facilitates learners to ask authentic questions and problems in real practice to provide meaningful learning experiences [14]. Meanwhile, inquiry-based learning (IBL) has a broader concept, because IBL aims to help learners understand learning concepts and social frameworks using the investigation process [15]. The difference between PBL and problem-based learning lies in the emphasis of the learning aspect. Problem-based learning emphasizes the learning process, while PBL emphasizes the process and product aspects [16]. PBL is also similar to experiential learning which emphasize on the process of learning, not the outcome [17]. Experiential learning theory is based on learning that emphasizes the formation of experiences. Ideas or concepts in experiential learning are derived from and continuously modified by experience, rather than on the utilization of the outcome. This is different from PBL which emphasizes on the collaborative learning process to contribute from sharing results and elements of reflection of active learning experiences [18]. Learners achieve learning objectives through a collaborative process involving projects, later learners will construct and present the final product by responding to the questions given.

2.2. Teachers' efficacy

Teachers' efficacy first emerged in 1976 when the RAND organization added two questionnaire items that led to the emergence of the concept of teachers' efficacy [19]. Teachers' efficacy is important characteristic to evaluation of teacher capabilities in considering possible desired outcomes of student engagement learning and performance [20]. Teachers' efficacy includes three dimensions: efficacy for student engagement, efficacy for classroom management, and efficacy for instructional strategies [13]. Efficacy for student engagement refers to the belief and confidence that teachers have in their ability to effectively engage and motivate their students in the learning process. Efficacy for classroom management refers to the belief and confidence that teachers have in their ability to establish and maintain a well-managed and orderly classroom environment. Efficacy for instructional strategies refers to the belief and confidence that teachers have in their ability to effectively implement a wide range of teaching methods and approaches to facilitate student learning and understanding.

2.3. Teachers' attitude toward project-based learning

Attitudes towards PBL play a crucial role in its successful implementation. Attitudes consist of three key components, including affective, cognitive, and behavioral factors [21]. The affective component

involves individuals' emotional responses towards an attitude object, leading to extensive research in this area. Teachers' attitude relies on emotional experiences and preferences, reflecting an individual's likes or dislikes towards the object. It is essential to note that the affective component should not be solely assessed based on beliefs, as emotions and cognition are intertwined. In the context of PBL, teachers' positive or negative attitudes towards PBL can significantly impact their learning strategies [22]. Teachers' attitudes refer to their overall evaluations, feelings, and beliefs towards various aspects of their profession, the educational context, students, and teaching practices and will impact on teachers' ability to use new approaches [23]. Change in teachers' attitudes could be used as evidence of the influence on teaching and learning that teachers have experienced [24].

3. THEORETICAL FRAMEWORK

In a cross-site analysis, the successful of implementation new approach have several barriers and dilemmas and is grouped into three dimensions: technical, political and cultural [6]. The technical dimension included limited ability to teach constructively, pre-existing commitments (e.g., to textbooks), assessment challenges, difficulties in group work, teacher and student role challenges, and inadequate in-service education. Political dimensions include limited in-service education (e.g., not continuous for several years), parental resistance, unresolved conflicts among teachers, lack of resources, and different judgments about fairness and equity. The cultural dimension is perhaps the most important because beliefs and values are so important-includes issues of textbooks, views on assessment, and the ethic of "preparation," e.g., the overriding commitment to "covering" because of the need to prepare students for the next level of schooling. The three dimensions will be the theoretical framework in this study to identify teachers' readiness to adopt PBL as a new approach as shown in Figure 1. There are three scales in the technical dimension that relate to teacher limitations in teaching constructively: knowledge dependence, motivation, and classroom management. Political dimension relates to teacher limitations caused by lack of support in implementing new approaches: resources, and system restrictions. The cultural dimension relates to teachers' beliefs and values which are analyzed through teachers' efficacy.

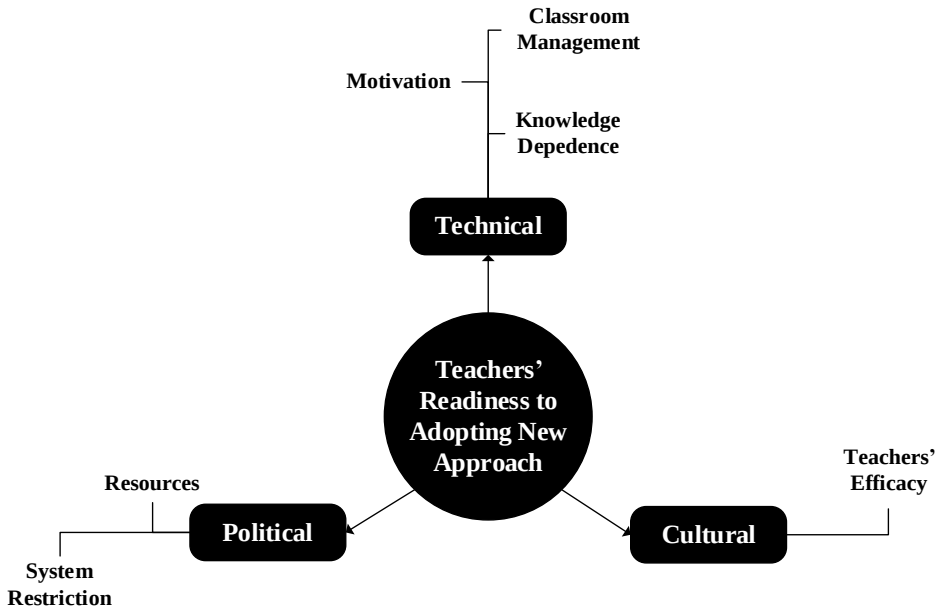

Figure 1. Theoretical framework to identify teachers' readiness to adopting new approach

4. RESEARCH METHOD

4.1. Research design

We employed a correlational descriptive design using survey studies [25]. This type of design is focused on observing and measuring relationships between different variables without any manipulation. The methodology is considered ex-post facto, meaning that we did not interfere with or change the subjects being studied [26]. Instead, we analyzed existing conditions and their interrelations. This approach allowed us to

identify patterns and correlations between variables. We chose this method because it is effective for studying natural occurrences. By not manipulating the subjects, we ensured the authenticity of our observations. This design is particularly useful for understanding the dynamics of variables as they naturally occur. The data collected through surveys provided insights into these relationships. Our findings were based on the observed correlations, which were analyzed to draw meaningful conclusions.

4.2. Participants

The participants are made up of a set of primary teacher education who had participated in collaborative work projects that made use of learning innovation by the 2022/2023 academic year at various primary schools in Yogyakarta, Indonesia. A total of 109 primary teachers participated and they are distributed to 22 male (20.2%) and 87 female (79.8%). Most of these teachers come from nationally accredited grade A schools (67.0%). The mean age of the participants was 37 and 72.5% of teachers have more than 9 years of teaching experience in primary education. Detailed information about the participants is summarized in Table 1.

Table 1. Description of study participants

Variable		N	% of total
Gender	Male	22	20.2
	Female	87	79.8
National	A	73	67.0
accreditation grade	B	36	33.0
Teachers' teaching	<8	30	27.5
experience (in years)	9-15	53	48.6
	>16	26	23.9

4.3. Data collection

Teachers' efficacy data was collected using the teachers' efficacy scale short form. The scale consists of 12 questions designed to measure efficacy for student engagement (items: 2, 3, 4, and 11), efficacy for classroom management (items: 1, 6, 7, 8), and efficacy for instructional strategies (items: 5, 9, 10, 12) [13]. Each item consists of a 9-point Likert scale that describes teachers' organizing in different situations. In Table 2, we found that the internal consistency was acceptable with a range of Cronbach's alpha from .704 to .816. We also calculated the mean inter-item correlation in each subscale with a range from .438 to .513.

Table 2. Factor loading and Cronbach's alpha for teachers' efficacy scale (N=204)

Dimension	Items/description	Cronbach's alpha	Mean inter-item correlation
Student engagement	How much can you do to get students to believe they can do well in schoolwork?	.704	.479
	How much can you do to help your students value learning?		
	How much can you do to motivate students who show low interest in schoolwork?		
	How much can you assist families in helping their children do well in school?		
Instructional strategies	To what extent can you use a variety of assessment strategies?	.816	.513
	To what extent can you provide an alternative explanation for example		
	To what extent can you craft good questions for your students?		
	How well can you implement alternative strategies in your classroom?		
Classroom management	How much can you do to control disruptive behavior in the classroom?	.734	.438
	How much can you do to get children to follow classroom rules?		
	How much can you do to calm a student who is disruptive or noisy?		
	How well can you establish a classroom management system with each group of students?		

As shown in Figure 1, teachers' attitude was used to analyze teachers' readiness in the technical and political dimensions. The instrument used was the teachers' attitude toward PBL scale which was modified from the instrument in PRIMAS project [27]. The scale consists of 17 items where teachers are asked to respond to each statement with criteria of strongly agree, agree, disagree, and strongly disagree. We also

added the routine use of PBL subscale to measure how often teachers use PBL. In our data, we analyzed internal consistency for teachers' attitude toward PBL scale and our result internal consistency as shown in Table 3. Generally, the internal consistency of the items is acceptable with range of Cronbach's alpha from .611 to .851.The mean inter-item correlation analysis had a variation from .376 to .418. The results of this analysis can be said to have met the criteria where the recommended mean inter-item correlation is in the range of .2 to .4 and the Cronbach's alpha value is greater than .5 [28].

Table 3. Subscale of teachers' attitude toward PBL scale with internal consistency measurement (N=204)

Subscale	Items/description	Cronbach's alpha	Mean inter-item correlation
Routine use of PBL	I already use PBL a great deal	-	-
	I regularly do projects with my students using PBL.		
	PBL is part of my daily teaching.		
Knowledge dependence	Successful PBL requires students to have extensive content knowledge	.611	.418
	PBL is not effective with lower-achieving students		
Motivation	PBL is well suited to overcome problems with students' motivation	.722	.397
	PBL is well suited to approach students' learning problems		
Resources	I do not have sufficient resources such as computers and laboratory	.687	.413
	I do not have access to any adequate professional development programs involving PBL		
	I do not have adequate teaching materials		
Classroom management	I think that group work is difficult to manage	.851	.376
	I worry about students' discipline being more difficult in PBL lessons		
	I do not feel confident with PBL. I worry about my students getting lost and frustrated in their learning		
System restriction	My students have to take assessments that do not reward PBL	.723	.361
	The number of students in my classes is too big for PBL to be effective		
	The curriculum does not encourage PBL		
	There is not enough time in the curriculum		

4.4. Data analysis

We used descriptive statistics on each item, including the mean, standard deviation, and percentages based on response categories, as well as dimensions of the questionnaire for the total participants. Q-Q plots were used to assess the normality of the data distributions visually which revealed that the data for the teachers' efficacy and teachers' attitude toward PBL subscales. The normal distribution was corrected by the Kolmogorov-Smirnov test with the Lilliefors. For comparing group means, we used t-tests with equal variance assumptions. In cases where the assumption of equal variances was violated, we used Welch's t-test to establish statistical differences. Additionally, when dealing with significantly different group sizes (1.5-fold difference), nonparametric Mann-Whitney U test was preferred. To determine statistical significance, we set the threshold at $p<.05$ for all tests. The data were analyzed with SPSS 20 statistics package.

5. RESULTS

5.1. The evaluation teachers' efficacy and teachers' attitude toward project-based learning

The results of teachers' efficacy and teachers' attitude toward PBL on each subscale are shown in Table 4. The mean of teachers' efficacy is 5.03, in which the student engagement subscale has the highest mean of 5.21, followed by classroom management at 5.01 and instructional strategies at 4.88. Meanwhile, the result of the mean analysis of teachers' attitude toward PBL shows a value of 2.89. The highest and lowest values in order are motivation at 3.20, classroom management at 3.10, system restriction at 3.00, resources at 2.70, and knowledge dependence at 2.54.

5.2. Relationship between level of project-based learning use and teachers' attitude toward PBL

The level of PBL use is differentiated based on the questionnaire results on the routine of use PBL subscale (Table 3). There were three items asked, namely "I already use PBL a great deal," "I regularly do projects with my students using PBL," and "PBL is part of my daily teaching." Since each item contains 4-point scale, the mean of the three items is grouped into "no or every little use" if it has lower mean than 2.5 and "somewhat or high use" if it has higher mean than 2.5. The grouping results found 47 teachers in the "no or very little use" group and 62 teachers in the "somewhat or high use" group. This resulted in approximately equally sized groups and the data of all subscales were normally distributed based on the results of

Kolmogorov-Smirnov and corrected by Lilliefors (p<.005). Independent samples t-test was used to test for differences in the 5 subscales among two groups of teachers. The t-test results reveal that teachers who often or always use PBL and rarely or never use PBL have a significant difference t(107)=8.600, p=.000, Cohen's d=1.701. These differences on each subscale are significant except for subscale of knowledge dependence t(107)=-1.971, p=.058, and system restriction t(107)=1.559, p=.122. We also calculated Cohen's d to display the effect size of each subscale that showed significant differences using mean and standard deviation data as shown in Table 5.

Table 4. Descriptive statistics for the teachers' efficacy and teachers' attitude toward PBL

Scale	Mean	Range	SD
1. Teachers' efficacy*	5.03	3.08-7.58	1.14
1.1. Student engagement	5.21	1.75-8.25	1.50
1.2. Instructional strategies	4.88	1.50-8.20	1.52
1.3. Classroom management	5.01	1.75-8.75	1.42
2. Teachers' attitude toward PBL	2.89	2.18-3.75	.26
2.1. Knowledge dependence	2.54	1.50-4.00	.41
2.2. Motivation	3.20	2.50-4.00	.41
2.3. Resources	2.70	1.00-4.00	.57
2.4. Classroom management	3.10	2.00-4.00	.44
2.5. System restriction	3.00	2.00-4.00	.36

* Scale from 1 to 9; ** Scale from 1 to 4

Table 5. Teachers' attitude toward PBL among teachers who have used PBL in the classroom

Subscale	N	Mean	t value	p	Cohen's d
Knowledge dependence					
No or every little use	47	2.63	-1.917	.058	-
Somewhat or high use	62	2.48			
Motivation*					
No or every little use	47	3.04	3.749	.000	.759
Somewhat or high use	62	3.32			
Resources*					
No or every little use	47	2.43	4.647	.000	.902
Somewhat or high use	62	2.90			
Classroom management*					
No or every little use	47	2.95	3.183	.002	.616
Somewhat or high use	62	3.21			
System restriction					
No or every little use	47	2.93	1.559	.122	-
Somewhat or high use	62	3.04			

*Differences between the groups are significant (p<.05)

5.3. Relationship between level of project-based learning use and teachers' efficacy

The method of analyzing the relationship between level of PBL use and teachers' efficacy uses the same method as that used in analyzing level of PBL use. The grouping results are approximately the same size, but the data results on each subscale are not normally distributed based on Kolmogorov-Smirnov and corrected by Lilliefors (p>.005). Due to the lack of normality, in the inferential analysis, nonparametric tests were used. Mann-Whitney U test was used to identify significant differences between level of PBL use and teachers' efficacy. The test results reveal that there is significant difference between teachers who often or always use PBL and rarely or never use PBL t(107)=8.102, p=.000, Cohen's d=2.541. The data in Table 6 shows that in all subscales of teachers' efficacy there are significant differences (p<.05). Cohen's d data was used to describe the effect size on each subscale.

Table 6. Teachers' efficacy among teachers who have used PBL in the classroom

Subscale	N	Mean	*U*	*Z*	p	Cohen's d
Student engagement*						
No or every little use	47	4.16	400.500	6.473	.000	1.553
Somewhat or high use	62	6.01				
Classroom management*						
No or every little use	47	3.80	391.000	6.533	.000	1.580
Somewhat or high use	62	5.69				
Instructional strategies*						
No or every little use	47	4.06	438.000	6.245	.000	1.453
Somewhat or high use	62	5.74				

*Differences between the groups are significant (p<.05)

5.4. Relationship between level of teachers' efficacy and teachers' attitude

Teachers' efficacy data was obtained based on the results of analyzing the teachers' efficacy scale which consists of a 9-point scale. Levels of teachers' efficacy were differentiated using the median split method. The median of teachers' efficacy is 5.17, hence the grouping is based on the distribution of the median data. Teachers who had a mean of less than 5.08 were grouped into "low teachers' efficacy" and teachers who had a mean of more than 5.25 were grouped into "high teachers' efficacy". The sample sizes of the median split results had relatively similar sample sizes and the Kolmogorov-Smirnov results with verification from Lilliefors revealed that the data were normally distributed ($p>.05$). Therefore, an independent sample t-test was prepared to test for significant differences between teachers who have low and high teachers' efficacy. Based on the results of the independent sample t-test revealed that there is a significant difference in teachers' attitude toward PBL between low teachers' efficacy and high teachers' efficacy $t(104)=5.784$, $p=.000$, Cohen's $d=1.125$. The data of t-test results to see the differences in each subscale of teachers' attitude toward PBL are shown in Table 7. The results of the independent sample t-test on each subscale show that there is a significant difference in teachers' attitude toward PBL between teachers who have low and high teachers' efficacy except on the subscale knowledge dependence $t(104)=-1.666$, $p=.099$. In each subscale of teachers' attitude, we also calculated Cohen's d to see the effect size of each subscale that has a significant difference.

Table 7. Teachers' attitude toward PBL among teachers who have low and high teachers' efficacy

Subscale	N	Mean	t value	p	Cohen's d
Knowledge dependence					
Low teacher efficacy	52	2.62	-1.666	.099	-
High teacher efficacy	54	2.48			
Motivation*					
Low teacher efficacy	52	3.10	2.604	.011	.508
High teacher efficacy	54	3.30			
Resources*					
Low teacher efficacy	52	2.48	3.999	.000	.776
High teacher efficacy	54	2.89			
Classroom management*					
Low teacher efficacy	52	3.00	2.332	.022	.453
High teacher efficacy	54	3.20			
System restriction*					
Low teacher efficacy	52	2.92	2.066	.041	.402
High teacher efficacy	54	3.06			

6. DISCUSSION

The Indonesian Government has set out to reform education with the jargon "*Kurikulum Merdeka*" or "freedom to learn." Starting in 2019, the reform is not only on the education management and financing system, but also covers the curriculum and learning implementation. In primary education, teachers are given an allocation of learning time as much as 20% of the total learning time to implement PBL. After the policy was established, we identified that there was a need to identify the readiness of teachers in using PBL.

6.1. Teachers' readiness to implement project-based learning based on teachers' attitude toward project-based learning

Our questionnaire analysis found that out of 109 primary teachers, 47 teachers were categorized in the "no or very little use" group and 62 teachers in the "somewhat or high use" group. The results found that 57% of teachers have routinely implemented PBL. Teachers' attitude of implementing PBL is related to teachers' attitude towards PBL, especially on the subscale of motivation, resources, and classroom management. This finding is similar to previous research which revealed that teachers' attitudes have a positive relationship with the PBL use [29]. The implementation of PBL needs habituation not only for teachers but also for students because PBL is an approach with in-depth investigation by producing meaningful products [1]. The learning atmosphere will be different from traditional learning, so the roles of teachers and students will be different.

We did not find significant differences in the subscale of knowledge dependence and system restriction, which indicates that practical experience is not enough to overcome all restrictions. It can be understood because PBL is an approach that teachers are familiar with and has continuously been added to teacher training. Teachers believe that successful PBL not requires students to have extensive content knowledge or PBL will be effective with low-achieving students. In addition, the implementation of the new curriculum provides time allocation of 20% of the total learning time. This policy can help teachers reduce

system restrictions that have been considered a limitation in the use of PBL [30]. In the future, efforts that need to be made to improve teacher readiness in using PBL are paying more attention to increasing motivation, resources, and classroom management. Increasing the subscale can be done by providing PBL implementation guidelines at each level of education that can be adapted and modified by teachers. In addition, providing opportunities for sharing sessions in the application of PBL in a community can also help teachers improve the subscale [31]. Each teacher can motivate each other, and share their experiences, for example, in developing project guidelines, students' group work management, managing student discipline, or anticipating students who are frustrated in learning.

6.2. Teachers' readiness to implement project-based learning based on teachers' efficacy

Our study found that there are differences in the routine use of PBL on each subscale of teachers' efficacy: student engagement, classroom management, and instructional strategies. This finding suggests that the use of PBL will have an impact on teachers' efficacy. Similar to previous research which found that the positive associations found between PBL and teacher self-efficacy indicates that instructional practice is not only an outcome of teacher self-efficacy, but also causes changes in teacher self-efficacy [32]. In particular, the teacher self-efficacy determines the use of constructivist instructional practices [33].

Relationship between routine of PBL use and teachers' efficacy is not only for in-service teachers, but also for pre-service teachers. Numerous researchers, including Manowaluilou and Reeve [34] have examined personal efficacy in undergraduate students and discovered that during the fourth year of their program, when they began teaching classes, there was a steady rise in their sense of efficacy. This finding is further supported by Bilgin *et al.* [35] who demonstrated that practicing teachers who pursued additional graduate courses in education displayed higher levels of personal efficacy in science teaching. Similarly, a study exploring the impact of PBL on undergraduate students' self-efficacy beliefs and achievement which observed a greater increase compared to those who were taught and learned science through traditional methods [35].

6.3. The impact level of teachers' efficacy to teachers' attitude toward project-based learning

We found that teachers who have higher teachers' sense efficacy have a more positive attitude. The highest influence is on resources when using PBL. Teachers who have high efficacy have a greater belief that PBL can be used even with limited school resources such as computers, laboratories, or professional development limitation. They can develop new ideas to cover the limitations of school resources. This is in line with Tschannen-Moran and Hoy [13] who state that a higher sense of teacher efficacy will provide opportunities to become teachers who are more open to new ideas and more willing to implement new approaches. This finding supports previous findings that teachers' efficacy is a determinant factor in a training session conducted in the use of new approaches [27]. Furthermore, within the group of teachers who receive training in mastery learning, those who had higher levels of self-efficacy tended to perceive mastery learning as more significant, better aligned with their current teaching methods, and less challenging to implement compared to teachers with lower self-efficacy [36].

However, on the knowledge dependence subscale, there was no significant difference among teachers who have low and high teachers' efficacy to teachers' attitude toward PBL. Although the direction of the relationship is not clear, teachers with low and high teachers' efficacy believe that successful PBL requires students to have extensive content knowledge and is not effective for low-achieving students. This finding differs from the previous finding that teachers' efficacy is related to teachers' attitude toward IBL on the knowledge dependence subscale [27]. This is possible because PBL is different from IBL. PBL facilitates learners to ask authentic questions and problems in real practice to provide meaningful learning experiences [14]. Meanwhile, IBL encompasses a more extensive concept, seeking to aid learners in comprehending educational concepts and societal structures through the process of investigation [15].

7. CONCLUSION

Overall, we conclude that teachers' readiness to implement PBL is influenced by teachers' efficacy and attitude toward PBL. The most dominant subscale of teachers' attitude toward PBL is motivation, resources, and classroom management. Meanwhile, the level of PBL use is not influenced by knowledge dependence and system restriction. The level of PBL use is also influenced by teachers' efficacy on all subscales: efficacy for student engagement, classroom management, and instructional strategies. This indicates that teachers who possess a higher sense of efficacy exhibit greater confidence in their abilities for classroom management, and this extends to their proficiency in managing classrooms during PBL lessons as well. Our study also found that the level of teachers' efficacy has a positive effect on teachers' attitude toward PBL on all subscales, except on the knowledge dependence subscale.

The implications of this study can provide an overview of the readiness of in-service primary teachers in an effort to encourage teachers to use PBL. Future professional development efforts can concentrate on practical training, including allocating more time for verbal persuasion, such as providing information about effective teaching strategies. Additionally, substitute experiences can be incorporated, such as conducting strategy demonstrations with local students, and protected mastery experiences can be encouraged through planning and practice sessions with colleagues. However, there are some limitations to our study. Firstly, our study did not measure the pre-post training sessions by including a control group, and therefore, we do not know if the same results would have emerged in a theoretical training. Secondly, the sample that participated in the training program was very small, hence the need for future studies that confirm our findings.

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REFERENCES

[1] D. Kokotsaki, V. Menzies, and A. Wiggins, "Project-based learning: a review of the literature," *Improving Schools*, vol. 19, no. 3, pp. 267–277, Nov. 2016, doi: 10.1177/1365480216659733.

[2] D. Tsybulsky and Y. Muchnik-Rozanov, "The development of student-teachers' professional identity while team-teaching science classes using a project-based learning approach: a multi-level analysis," *Teaching and Teacher Education*, vol. 79, pp. 48–59, Mar. 2019, doi: 10.1016/j.tate.2018.12.006.

[3] E. Marasco and L. Behjat, "Integrating creativity into elementary electrical engineering education using CDIO and project-based learning," in *2013 IEEE International Conference on Microelectronic Systems Education (MSE)*, Austin, TX, USA: IEEE, Jun. 2013, pp. 44–47, doi: 10.1109/MSE.2013.6566701.

[4] A. Wahyudi, S. Liliasari, T. Supriyanti, and N. Nahadi, "Biochemistry course achievement of pre-service chemistry teachers at one of Islamic institution of teachers training program in Bandung," *Journal of Physics: Conference Series*, vol. 1157, no. 4, p. 042020, Feb. 2019, doi: 10.1088/1742-6596/1157/4/042020.

[5] J. Morrison, J. Frost, C. Gotch, A. R. McDuffie, B. Austin, and B. French, "Teachers' role in students' learning at a project-based STEM high school: implications for teacher education," *International Journal of Science and Mathematics Education*, vol. 19, no. 6, pp. 1103–1123, Aug. 2021, doi: 10.1007/s10763-020-10108-3.

[6] R. D. Anderson, "Reforming science teaching: what research says about inquiry," *Journal of Science Teacher Education*, vol. 13, no. 1, pp. 1–12, Feb. 2002, doi: 10.1023/A:1015171124982.

[7] T. R. McKeown, L. M. Abrams, P. W. Slattum, and S. V. Kirk, "Enhancing teacher beliefs through an inquiry-based professional development program," *Journal of Education in Science, Environment and Health*, vol. 2, no. 1, pp. 85–97, Jul. 2016, doi: 10.21891/jeseh.30143.

[8] B. J. Fishman, R. W. Marx, S. Best, and R. T. Tal, "Linking teacher and student learning to improve professional development in systemic reform," *Teaching and Teacher Education*, vol. 19, no. 6, p. 643, 2003, doi: 10.1016/S0742-051X(03)00059-3.

[9] V. B. Gómez-Pablos, M. M. del Pozo, and A. G.-V. Muñoz-Repiso, "Project-based learning (PBL) through the incorporation of digital technologies: an evaluation based on the experience of serving teachers," *Computers in Human Behavior*, vol. 68, pp. 501–512, Mar. 2017, doi: 10.1016/j.chb.2016.11.056.

[10] D. Yang, S. Skelcher, and F. Gao, "An investigation of teacher experiences in learning the project-based learning approach," *Journal of Education and Learning (EduLearn)*, vol. 15, no. 4, pp. 490–504, Nov. 2021, doi: 10.11591/edulearn.v15i4.20302.

[11] K. L. McNeill, D. S. Pimentel, and E. G. Strauss, "The impact of high school science teachers' beliefs, curricular enactments and experience on student learning during an inquiry-based urban ecology curriculum," *International Journal of Science Education*, vol. 35, no. 15, pp. 2608–2644, Oct. 2013, doi: 10.1080/09500693.2011.618193.

[12] H. Yoon, A. J. Woo, D. Treagust, and A. Chandrasegaran, "The efficacy of problem-based learning in an analytical laboratory course for pre-service chemistry teachers," *International Journal of Science Education*, vol. 36, no. 1, pp. 79–102, Jan. 2014, doi: 10.1080/09500693.2012.727041.

[13] M. Tschannen-Moran and A. W. Hoy, "Teacher efficacy: capturing an elusive construct," *Teaching and Teacher Education*, vol. 17, no. 7, pp. 783–805, Oct. 2001, doi: 10.1016/S0742-051X(01)00036-1.

[14] K. Brundiers and A. Wiek, "Do we teach what we preach? An international comparison of problem-and project-based learning courses in sustainability," *Sustainability*, vol. 5, no. 4, pp. 1725–1746, Apr. 2013, doi: 10.3390/su5041725.

[15] R. I. Arends and A. Kilcher, *Teaching for student learning: becoming an accomplished teacher*. New York, NY, USA: Taylor & Francis, 2010.

[16] M. Genc, "The project-based learning approach in environmental education," *International Research in Geographical and Environmental Education*, vol. 24, no. 2, pp. 105–117, Apr. 2015, doi: 10.1080/10382046.2014.993169.

[17] D. A. Kolb, *Experiential learning: experience as the source of learning and development*. New York, NY, USA: Pearson Education, 2015.

[18] P. Guo, N. Saab, L. S. Post, and W. Admiraal, "A review of project-based learning in higher education: student outcomes and measures," *International Journal of Educational Research*, vol. 102, p. 101586, 2020, doi: 10.1016/j.ijer.2020.101586.

[19] E. M. Skaalvik and S. Skaalvik, "Dimensions of teacher self-efficacy and relations with strain factors, perceived collective teacher efficacy, and teacher burnout.," *Journal of Educational Psychology*, vol. 99, no. 3, pp. 611–625, Aug. 2007, doi: 10.1037/0022-0663.99.3.611.

[20] S. Bal-Taştan *et al.*, "The impacts of teacher's efficacy and motivation on student's academic achievement in science education among secondary and high school students," *EURASIA Journal of Mathematics, Science and Technology Education*, vol. 14,

no. 6, pp. 2353–2366, Mar. 2018, doi: 10.29333/ejmste/89579.
[21] T. Q. Tran and T. N. P. Tran, "Attitudes toward the use of project-based learning: a case study of Vietnamese high school students," *Journal of Language and Education*, vol. 6, no. 3, pp. 140–152, Sep. 2020, doi: 10.17323/jle.2020.10109.
[22] J. Railsback, *Project-based instruction: creating excitement for learning*. Oregon: Northwest Regional Educational Laboratory, 2002.
[23] S. Lam, R. W. Cheng, and H. C. Choy, "School support and teacher motivation to implement project-based learning," *Learning and Instruction*, vol. 20, no. 6, pp. 487–497, Dec. 2010, doi: 10.1016/j.learninstruc.2009.07.003.
[24] M. K. Al Salami, C. J. Makela, and M. A. de Miranda, "Assessing changes in teachers' attitudes toward interdisciplinary STEM teaching," *International Journal of Technology and Design Education*, vol. 27, no. 1, pp. 63–88, Mar. 2017, doi: 10.1007/s10798-015-9341-0.
[25] W. Wiersma and S. G. Jurs, *Research methods in education: an introduction*. Boston, MA, USA: Pearson Education, 2009.
[26] J. W. Creswell, *Educational research: planning, conducting, and evaluating quantitative and qualitative research*, 4th ed., Boston, MA: Pearson, 2012.
[27] G. Silm, K. Tiitsaar, M. Pedaste, Z. C. Zacharia, and M. Papaevripidou, "Teachers' readiness to use inquiry-based learning: an investigation of teachers' sense of efficacy and attitudes toward inquiry-based learning," *Science Education International*, vol. 28, no. 4, pp. 315–325, 2017.
[28] A. Wahyudi, R. Richardo, I. Eilks, and C. Kulgemeyer, "Development of three tier open-ended instrument to measure chemistry students' critical thinking disposition using Rasch analysis," *International Journal of Instruction*, vol. 16, no. 3, pp. 191–204, Jul. 2023, doi: 10.29333/iji.2023.16311a.
[29] S. Khan and L. Mohakud, "Teacher's attitude towards effectiveness of project based learning (PBL) at higher secondary level in West Bengal," in *Proceeding of UGC AIDED International Seminar on Enhancing Quality in Education*, 2016, pp. 240–251.
[30] D. E. Kanter and S. Konstantopoulos, "The impact of a project-based science curriculum on minority student achievement, attitudes, and careers: the effects of teacher content and pedagogical content knowledge and inquiry-based practices," *Science Education*, vol. 94, no. 5, pp. 855–887, Sep. 2010, doi: 10.1002/sce.20391.
[31] J. Farrow, S. Kavanagh, and P. Samudra, "Exploring relationships between professional development and teachers' enactments of project-based learning," *Education Sciences*, vol. 12, no. 4, p. 282, Apr. 2022, doi: 10.3390/educsci12040282.
[32] J. Choi, J.-H. Lee, and B. Kim, "How does learner-centered education affect teacher self-efficacy? The case of project-based learning in Korea," *Teaching and Teacher Education*, vol. 85, pp. 45–57, Oct. 2019, doi: 10.1016/j.tate.2019.05.005.
[33] Y. Nie, G. H. Tan, A. K. Liau, S. Lau, and B. L. Chua, "The roles of teacher efficacy in instructional innovation: its predictive relations to constructivist and didactic instruction," *Educational Research for Policy and Practice*, vol. 12, no. 1, pp. 67–77, Feb. 2013, doi: 10.1007/s10671-012-9128-y.
[34] N. Manowaluilou and E. M. Reeve, "Pre-service teachers' self-efficacy support systems resulting in a desire to become teachers," *International Education Studies*, vol. 15, no. 2, pp. 41–53, Mar. 2022, doi: 10.5539/ies.v15n2p41.
[35] I. Bilgin, Y. Karakuyu, and Y. Ay, "The effects of project based learning on undergraduate students' achievement and self-efficacy beliefs towards science teaching," *EURASIA Journal of Mathematics, Science and Technology Education*, vol. 11, no. 3, pp. 469–477, Apr. 2015, doi: 10.12973/eurasia.2014.1015a.
[36] M. Tschannen-Moran and P. McMaster, "Sources of self-efficacy: four professional development formats and their relationship to self-efficacy and implementation of a new teaching strategy," *The Elementary School Journal*, vol. 110, no. 2, pp. 228–245, Dec. 2009, doi: 10.1086/605771.

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