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The role of the project-based learning approach in optimizing student involvement in the learning process

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Abstract

This research is motivated by the problem of the contribution of project-based learning (PBL) to the learning process which only helps the teacher's task or has a significant contribution to the acquisition of student knowledge. The aim of the research is to investigate the effectiveness of PBL in involving students in the learning process, the contribution of PBL to authentic, iterative, collaborative, and student discipline learning. The research method used is factorial design analysis using structural equation models. The participants involved in this study were 250 teachers who used PBL in their learning process. This data was collected using a questionnaire to determine the role of PBL from the five aspects highlighted. This study uses the SEM-AMOS (Structural Equation Modelling) measurement model as the main statistic to analyse data and is based on confirmatory factor analysis. The findings show that all the main aspects of learning methods such as authentic, disciplined, collaborative, repetitive learning and student engagement are significantly correlated with PBL. Through these main aspects, PBL is able to involve students optimally in participating in the learning process. They can be more optimal in obtaining new knowledge and information in the learning process. So, in addition to optimizing student involvement in the learning process, PBL also facilitates students to optimally acquire knowledge in the learning process.

Keywords: Project-based learning, authentic learning, structural equation model, student involvement in learning.

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1. Introduction

Most of the methods or approaches used in the learning process focus on facilitating students to master the material according to the curriculum. There is still little research that focuses on the process of using these approaches or methods. Likewise research, most of the previous research has raised the effectiveness of a method in facilitating students to master the material (Moghaddas & Khoshsaligheh, 2019; Mouton, 2020; Owens & Hite, 2020). However, there is still little research that raises certain methods that focus on the process or involvement of students in each designed activity. Through this study, researchers seek to uncover student involvement in project-based learning (PBL). This research is based on the government's efforts to encourage teachers to be able to provide learning process practices that optimize student involvement in the learning process, and all students must receive services to get active and extensive learning opportunities (Estrada Oliver et al., 2020; Mitchell & Rogers, 2020). The use of PBL in the learning process by teachers is one approach to reduce or eliminate traditional methods such as rote learning.

Several terms are used by researchers to mark learning processes that prioritize understanding, including understanding learning, intellectual learning, and authentic pedagogy. All of these terms imply that ideas or ideas obtained by students must be facilitated by the teacher to be explored together. There are things that must be considered when referring to such a learning process, namely the design of teaching instructions must be discussed with students in facilitating students to achieve learning goals through meaningful processes (Cummings & Yur-Austin, 2022; Dobson & Dobson, 2021). So, the PBL is a learning method that focuses on the experience of the learning process and the preparation of the teacher in carrying out the design of instructional learning activities. The experience of a meaningful learning process that involves students as a whole optimally will be more meaningful and attached to the knowledge gained.

Several PBL techniques that are often used among teachers, one of which is modelling and discussion facilities. The design of PBL learning activities is influenced by various factors including the ability and experience of the teacher. The teacher's experience will greatly influence the design of instructions and the teacher's efforts to involve students optimally in the process of learning activities (Hanham et al., 2020; Hugerat, 2016). This PBL approach is in accordance with the characteristics of group education or facilitating students to learn through levels using a class system. An approach or method must certainly pay attention to educational goals and learning objectives in designing instructions or stages of activity (Lin, 2018; Maluleka, 2020). Stakeholders promoting the PBL approach are one of the factors in the design of instructional activities that encourage students to be optimally involved in the learning process. The research study addressed the development of 25 student-teachers' professional identities during their pedagogical practicum while teaching science classes using a PBL approach (Fernandes et al., 2014). Other studies that address PBL in science practicums show that student-teacher professional identities are shaped by meaningful experiences on two dimensions: overcoming challenges while guiding students through PBL and engaging in fruitful and supportive partnerships with their peers. The development of student and teacher identities has changed from a group to an individual, professional, empowered, and increased self-confidence (Tsybulsky & Muchnik-Rozanov, 2019).

However, there is no comprehensive research that reveals the experiences of students and teachers when participating in the learning process using the PBL approach, especially when students and teachers interact in various contexts and settings. The difference between this study and previous research is the role of PBL in involving students from various perspectives and learning contexts. So, the aim of the research is to analyse the effectiveness of PBL in optimizing student involvement in the learning process in various contexts. This study investigates the aspects contained in PBL, namely collaborative learning (CL), student discipline, iterative, authentic, and student involvement in the learning process. This study proposes the formulation of the problem, namely 1) what is the correlation between the main aspects of PBL? 2) what is the role of PBL in involving students in the learning process?

2. Literature Review

2.1. Project-based learning

PBL contains the meaning of collaboration between students and teachers in carrying out instructional learning activities to achieve learning objectives. In the process, PBL pays attention to expertise between teachers, discussion, and critical dialogue in carrying out teaching instructions (Maros et al., 2021; Tanaka, 2022). This PBL does not only provide opportunities for students but also provides opportunities for teachers who do not have experience to get various learning activities as well as get opportunities for professional development and personal competence (Miller & Krajcik, 2019; Mioduser & Betzer, 2008). Students who work in teams allow students to play the role of experts so that they get meaningful learning experiences. Collaboration between teachers and students in this PBL will get important findings during learning, the findings and understanding obtained by students will be more meaningful and easy to remember. Topics, themes or problems presented in the learning process are discussed from various views that will broaden students' horizons, so that their views of the material become open and in-depth. Through this PBL, teachers and students get a lot of benefits from the process, including getting emotional support, improving the quality of learning activities, and developing personal abilities such as self-confidence (Vesikivi et al., 2020; Waite, 2020). Teachers and students can monitor their interaction activities and learning experiences. Teachers can improve their performance more through collaboration than through individual performance.

Therefore, PBL is very important to train teachers and students to establish professional relationships in order to achieve shared learning goals. In the PBL training process, there is also feedback from teachers which indirectly trains teachers to improve their quality as teachers. So, besides being able to use PBL to achieve learning objectives, PBL can also improve teaching professionalism (Simonton et al., 2021; Tsybulsky et al., 2020). However, PBL is also inseparable from shortcomings including the process of PBL activities planning, participatory, reflection which takes a lot of time, group members who are not friendly and collaborative, individual student achievements sometimes make the teacher distinguish these students, students who experience less will experience difficulties when working in groups, need to get guidance from fellow students and teachers.

The PBL approach is a learning method that has the characteristics of learning that prioritizes cooperative, collaborative, involves students in research or projects, and encourages students to be optimally active in the learning process (Mohamadi, 2018; Tanaka, 2022). Teachers who use PBL in their learning activities facilitate students to be able to solve problems, develop products, assess results and the manufacturing process. PBL is a learning method that is in accordance with current competency demands because in PBL students are equipped with critical thinking, problem-solving, information literacy, collaborative, creative, and innovative skills (Dobson & Dobson, 2021; Hanham et al., 2020). Several previous studies have investigated the effectiveness of PBL in improving students' problem-solving abilities and student academic achievement (Cummings & Yur-Austin, 2022; Hugerat, 2016). The research proves that PBL is effective in improving students' academic achievement and problem-solving abilities. In addition, other studies also prove that PBL is able to improve the quality of the teaching profession because PBL helps teachers increase teacher awareness of the importance of student experience when following the process to achieve learning goals. In the PBL process, students are given the opportunity to solve complex problems and continuously train students' critical thinking to find answers, complete projects, criticize, and reflect on learning outcomes.

2.2. Collaborative learning

A good learning process is that the teacher not only provides new knowledge to students, but students must be invited to discuss, criticize, or even revise this new knowledge during the learning process (Leggett & Harrington, 2021; Lin et al., 2021). The PBL model was adopted to facilitate students with learning difficulties individually, so it is not uncommon for only a few students to be active during the learning process. To overcome this, a PBL model was created so that students are optimally involved during the learning process. In its implementation, PBL contains very strong components, namely collaboration,

cooperative, internalization, adaptation, discussion, reflection, criticism, and discipline to acquire new knowledge during the learning process (Li et al., 2021; Owens & Hite, 2020). CL is one way to facilitate students so that students are able to gain meaningful knowledge and experience in achieving learning goals. Several previous studies have been conducted, PBL is proven to be able to improve the quality of student learning outcomes through collaboration to produce learning projects (Moghaddas & Khoshsaligheh, 2019; Sherman et al., 2019). This PBL method equips students to have the skills that are needed at this time. In addition, PBL also requires a learning environment that supports student learning processes to be optimal. The characteristics of the environment needed when using PBL include instructional design that directs students to always think critically, collaborate, and reflect on the knowledge gained.

2.3. Discipline learning (DL)

The design of collaborative PBL activities is able to encourage students to develop their discipline in learning new information, and integrating it to examine previous knowledge in order to add and broaden knowledge. PBL which prioritizes discipline and collaboration can effectively improve students' information technology abilities, as well as their integration into science and other knowledge (Mouton, 2020; Owens & Hite, 2020). Basically, PBL is used by teachers so that students are able to learn disciplines related to the context of problems faced by students in real life. From previous research, PBL has proven to be effective in facilitating students not only to learn and improve information and technology skills but to increase discipline in learning new things (Maros et al., 2021; Miller & Krajcik, 2019). Good learning is learning that is able to facilitate students to be able to learn new things across disciplines. This PBL transforms learning concepts that originate from absolute truth into a process for negotiating these concepts or findings. In addition, the PBL environment is also dynamic, or power in the classroom is not held by the teacher but is equally distributed to all involved, such as students, teachers, and disciplined instructions or practices.

2.4. Authentic learning (AL)

One way for students to get meaningful learning experiences is by involving students in the learning process in a disciplined manner and presenting problems that are appropriate to students' real lives. AL is learning that involves students responsively and authentically in carrying out activities designed by the teacher (Tsybulsky et al., 2020; Vesikivi et al., 2020). A teacher must be able to design activities that encourage students to carry out tasks responsively and carry out authentic assignments in order to generate new ideas or knowledge. In PBL, students are encouraged to be able to develop new ideas, evaluate their own ideas and those of their friends, and reflect on them. It is intended that new material or knowledge obtained is deep and broad (Waite, 2020; You, 2021). Currently, the learning method that is widely used by teachers is a learning method that is simulation and training without considering student participation to negotiate, criticize, and reflect on students' ideas or ideas, so students are not optimal in acquiring new knowledge in the learning process.

In the PBL process, students are naturally encouraged and given the opportunity to respond, criticize, and evaluate the thoughts of other students or teachers. This condition is a very supportive learning environment for students without having to create teaching simulations. Basically, the goal of PBL is to facilitate students to acquire functional and meaningful knowledge in real life facilitated by authentic assignments (Cummings & Yur-Austin, 2022; Leggett & Harrington, 2021). Students will find it difficult to gain meaningful knowledge or skills if the teacher only does simulations and forgets the essence of what he is learning. So, the authentic aspect of PBL is that the material or knowledge presented is not only needed in class but also equips students with knowledge and skills that are useful in real life. In addition, PBL also provides authentic assignments so that students are used to solving authentic and complex problems that are very useful in their lives.

2.5. Repeated learning

Learning process activities that use PBL go through several processes including questions asked by students repeatedly, actively, participatively, responsively, critically, and reflectively. In addition, PBL is also

in the process of facilitating students to collect repeated data, look for new findings, test results, reflect, test, evaluate reasoning and logic, and receive and evaluate input or ideas from friends and teachers (de la Puente Pacheco et al., 2021; Mouton, 2020). In order to facilitate the iterative nature of the learning process in PBL, students and teachers work together to give, receive, and provide feedback continuously. The teacher acts as a simplification of learning activities by carrying out formative evaluations. In addition, teachers can also carry out repeated feedback during the inquiry stages until the discovery of new knowledge. This idea is based on a theory which states that learning will be effective if feedback is given repeatedly, not just once. Feedback in PBL is considered a learning process not a one-time improvement (Moghaddas & Khoshsaligheh, 2019; Sanchez-Muñoz et al., 2020). So, in the PBL process, students who receive feedback repeatedly can not only improve their mastery of the material but can also increase students' motivation and perceptions of mastery of the material.

2.6. Student engagement in learning

The assumption regarding learning that is currently still a reference for most is that the teacher is in charge of conveying and students are listening. This assumption has been used since ancient times, namely the task of the teacher to convey knowledge to students who are passive. This assumption is currently challenged by practitioners, educators, stakeholders and researchers. A good learning process is not only for teachers to convey knowledge, but students must also be active in evaluating and negotiating this knowledge (Estrada Oliver et al., 2020; Miranda et al., 2020). The implementation of this PBL approach is based on a good learning process, namely the active interaction of teachers and students and carrying out productive activities in order to create a meaningful learning process and achieve learning goals effectively (Alvarez, 2021; Cummings & Yur-Austin, 2022). Any learning activity will be better if all participants are actively involved, not just one person. This activity has been improved from time to time by educational practitioners. PBL is an alternative learning method that involves students to participate actively and considers the wishes of students in the process to achieve learning goals. PBL has principles that not only facilitate students academically, but also facilitate students to have social and interaction skills, and critical thinking that is needed at this time.

3. Method

The research method used in this study is a factorial analysis design to see the relationship between PBL and its main aspects and the role of PBL in involving students optimally in the learning process. The five aspects used in evaluating PBL are the main components that must exist in a learning method including CL, DL, repetitive learning, AL, and student involvement in the learning process (Hugerat, 2016; Maros et al., 2021). Researchers used a questionnaire to investigate these five aspects and student engagement. The participants involved in this study were teachers with various educational backgrounds. The questionnaire used uses a Likert scale with 5 points consisting of 25 items to reveal these 5 aspects. The range of points used were 1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, and 5 = strongly agree. The sample was selected using a simple random sampling technique. Response data from the participants obtained were analysed using the Statistical Package for the Social Sciences application. Researchers used the structural equation model (AMOS) to analyze the data through two stages. The first stage was carried out to determine the structure, convergence, and determine difference in the validity of the assessment model, the second stage was carried out to test the structural equation model.

3.1. Research instruments

The instruments used in this study were two main questionnaires. First, a questionnaire was used to obtain demographic information on teachers who were participants in this study. This data was collected to determine teacher demographic data such as age, gender, and frequency of using PBL while teaching. The second questionnaire was used to reveal the relationship between PBL and the five aspects, namely aspects of CL, DL, repetitive learning, AL, and student involvement in the learning process. The questionnaire contains 25 items to reveal the relationship between PBL and aspects of CL, DL, repetitive learning, AL. Items to reveal these four aspects were adapted from Grossman et al. (2019). The second

questionnaire consists of 10 items that are used to reveal the role of PBL in involving students in the learning process. Items in the second questionnaire were adopted from Grossman et al. (2019).

3.2. Participant

The participants involved in this study totalled 250 teachers consisting of 150 (60%) male teachers and 100 (40%) female teachers. With a composition of 70 teachers aged 26–30 years, 80 teachers aged 36–46 years, 60 teachers aged 47–50 years, and 40 teachers aged over 51 years. The composition of the educational level of the teachers involved, namely 60 teachers with diploma education, 100 teachers with undergraduate education, 50 teachers with master education, 40 teachers with doctoral education. The composition of the teaching fields involved are 50 teachers in arts and humanities, 100 teachers in education, 80 teachers in natural sciences, and 20 teachers in computer science.

3.3. Data analysis and results

Researchers examine the variables that affect aspects of collaboration and communication during the learning process by proposing a Cronbach reliability coefficient of 0.950. This study tested the validity using the criteria for a lower variable index value of 0.82, the average variance (AVE) assuming a value equal to or greater than 0.5, and an AVE square value that was greater than the intercorrelation between variables. From the results of item testing and examination of the main aspects, Cronbach's alpha factor value is 0.8 and more, so that value is acceptable. In addition, a composite confidence value of 0.75 and more was obtained. Of the two values, both values meet the criteria. Testing the factor value and composite trust value can be seen in Table 1.

Table 1

Results of Analysis of Model Fit and Reliability

Measure type	Acceptable level	Model of measurement	Model of structural
Root mean square residual (RMSR)	Near to 0 (perfect fit)	0.034	0.035
Incremental fit index (IFI)	X = or > 0.81	0.08542	0.0835
Normed fit index (NFI)	X = or > 0.81	0.0874	0.0861
Relative fit index (RFI)	X = or > 0.81	0.0861	0.0835
Comparative fit index (CFI)	X = or > 0.81	0.0836	0.0853
Tucker–Lewis index (TLI)	X = or > 0.81	0.0854	0.0873
Root mean square error of approximation (RMSEA)	X < 0.12 = good fit, and X < 0.05 = very good fit	0.043	0.052
Factors	AVE	Composite reliability	Cronbach's α
PBL	0.678	0.840	0.824
Collaborative	0.725	0.953	0.887
Discipline	0.745	0.989	0.951
Iterative	0.724	0.895	0.940
Authentic	0.748	0.915	0.947
Student involvement	0.727	0.927	0.958

3.4. Measurement model analysis

This study uses the SEMAMOS measurement model as the main statistic to analyze data and is based on confirmatory factor analysis. In addition, this study also uses convergent validity, consistency, in one dimension, and uses discriminant validity. In addition, evaluation of structural equation models with high probability procedures must use aligned pairing strategies, including using chi-square, RFI, normed chi-square, NFI, TLI. IFI, CFI, RMR, parsimonious goodness-of-fit index, and RMSEA.

4. Results

Researchers conducted a discriminant validity test on the equation model to check the level of understanding and various factors related to PBL. Based on the test results, the AVE value shows more than 0.51 with *p*: 0.001. This value indicates that the data meets discriminant validity for all structures. The relationship between elements does not exceed the square root of the AVE in any of the model structures. Based on the results of data processing, the composite reliability value is in the range of 0.72 or more, Cronbach's alpha value is in the range of 0.71 or more, and the AVE value is in the range of 0.55 or higher. From the results of the discriminant validity test, the total factor value exceeds 0.50, so it can be concluded that it meets the discriminant validity test. The results of the discriminant validity test can be seen in Table 2.

Table 2

Validity of Discriminant

Variables	PBL	Collaborative	Discipline	Iterative	Authentic	Student involvement
PBL	**0.945**					
Collaborative	0.542	**0.926**				
Discipline	0.653	0.624	**0.889**			
Iterative	0.589	0.573	0.560	**0.916**		
Authentic	0.487	0.487	0.552	0.567	**0.892**	
Student involvement	0.590	0.557	0.489	0.478	0.536	**0.914**

4.1. Structural equation model analysis

Researchers analysed aspects of student involvement in PBl, aspects of CL, DL, repetitive learning, and AL with path modelling analysis to answer the problems formulated. Based on the results of the analysis found a significant correlation between PBL and CL (β = 0.280, t = 8.824, p < 0.001). All participants responded that PBL can improve CL. Furthermore, there is a significant correlation between PBL and DL with scores (H2; β = 0.091, t = 3.367, p < 0.001). In this aspect, all participants also agreed that PBL can improve student DL. There was also a positive and significant relationship between PBL and AL with scores (β = 0.458, t = 9.768, p < 0.001). This means that teachers also view that PBL has an influence on the AL that students get. PBL also ultimately had a significant impact on student involvement with scores (β = 0.458, t = 8.886, p < 0.001) which means that participants agreed that through PBL students could be optimally involved in the learning process. In addition, PBL also had a positive and significant correlation with repeated teaching with scores (β = 0.263, t = 5.648, p < 0.001).

Researchers also analyze the relationship between the main aspects. Based on the results of the analysis, it was found that CL had a significant effect on AL with a value (β = 0.326, t = 6.248, p < 0.001). In addition, CL also has a significant effect on the level of student involvement during the learning process with a value (β = 0.521, t = 11.683, p < 0.001). In addition, a significant relationship was found between DL and repetitive learning with scores (β = 0.530, t = 11.145, p < 0.001). DL is also able to involve students optimally with a value (β = 0.353, t = 8.463, p < 0.001). AL in PBL is also able to involve students optimally in the learning process with a value (β = 0.316, t = 8.542, p < 0.001). Finally, a significant and positive correlation was found between AL and student involvement in the learning process with scores (β = 0.425, t = 9.873, p < 0.001). The correlation relationship between the variables investigated can be seen in Table 3.

Table 3

Correlation Between Variables

Variables	PBL	Collaborative	Discipline	Iterative	Authentic	Student involvement
PBL	**0.945**					
Collaborative	0.542	**0.926**				

Discipline	0.653	0.624	**0.889**			
Iterative	0.589	0.573	0.560	**0.916**		
Authentic	0.487	0.487	0.552	0.567	**0.892**	
Student involvement	0.590	0.557	0.489	0.478	0.536	**0.914**

4.2. Factor analysis

Based on the results of the analysis, the majority of teachers who were involved as research participants agreed that PBL had a positive contribution to CL. So, this study explains that it influences CL and increases student involvement in the learning process by 38% agreeing and 42% responding strongly agree. In addition, this study also found that the majority of teachers responded that DL can increase student engagement during the learning process with 46% agreeing and 26% responding strongly agree. Research has also found that the majority of teachers agree that PBL makes a positive contribution to AL. So, through this research, PBL provides an overview of teachers' views on AL which can increase student engagement with 51% agreeing and 28% responding strongly agree. The findings also revealed that some participants agreed that PBL had a positive effect on repetitive learning. So, it can be concluded that most of the participants view that through PBL teachers can improve AL while optimizing student involvement in the learning process with 41% agreeing and 21% responding strongly.

The research findings also show that most participants agree that PBL can optimize student engagement during the learning process. So, based on the results of the study, it was found that teachers thought that PBL was considered to be able to increase student involvement while at the same time increasing aspects of collaborative, authentic, iterative learning, and DL with a value of 35% of participants giving responses that agreed and 28% gave responses that strongly agreed. In addition, the research findings also reveal that teachers agree that PBL has a positive and significant impact on CL, DL, repetitive learning, AL, and student engagement. Teachers view that PBL is considered a learning method that makes a positive contribution to CL, DL, repetitive learning, and AL with a percentage of teacher responses of 42% agreeing and 13% strongly agreeing.

5. Discussion

This study seeks to reveal the correlation of PBL with the main aspects that support the learning process through the views of the teachers involved. Through this research, researchers can provide an assessment of the role of PBL in optimally involving students and achieving learning objectives effectively. The main aspects investigated in relation to PBL are CL, DL, repetitive learning, AL, and their role in engaging students. Through this research, teachers can find out the role of PBL in activating the main components in the learning process so that students are optimally involved during the learning process. The main aspect of a learning method that is used is in accordance with the theory that a good learning method is a learning method that is able to activate all the main components that encourage students to be optimally involved during the learning process (Naar et al., 2021; Ruiz-Rosa et al., 2021). Research findings show that teachers' views on PBL in general can increase student engagement optimally.

The research findings show that through PBL teachers can improve information technology knowledge and skills through the main aspects of PBL such as CL, DL, repetitive learning, and AL which in turn can involve students optimally from the beginning to the end of learning (Miller & Krajcik, 2019; Mioduser & Betzer, 2008). In addition, through PBL, teachers can carry out activities not only transferring knowledge, but teachers can invite students together to explore, evaluate, negotiate, and reflect on new ideas, ideas or knowledge discovered during the learning process. This is in accordance with the theory that the active involvement of these students can not only improve academic abilities but also improve their supporting skills (Maros et al., 2021; Simonton et al., 2021). So, it can be concluded that PBL is a learning method that is able to present AL that is able to train students to solve problems in accordance with real life.

In addition, the findings show that the interaction activities in the PBL process are consistently maintained from start to finish through the main components that appear in each instructional learning activity, so that there are no students who are passive during the learning process. The PBL method can encourage students to produce work through authentic assignments, and can solve complex problems through collaboration and active participation of students optimally in the learning process. In addition, PBL is also able to provide opportunities for students to determine their own needs, so that they become independent students and problem solvers in real life (Vesikivi et al., 2020; Waite, 2020). PBL is believed to be able to connect students with material and colleagues, so as to be able to create a learning environment that encourages students to continue to actively participate which in turn is able to optimally involve students in the learning process. The results of this study confirm that PBL provides all the main aspects of the learning method so that it can optimally involve students in the learning process. The findings of this study are in accordance with previous research which proves that PBL is able to improve academic abilities equally for all students because it provides the main aspects of a learning method (Maros et al., 2021; You, 2021).

The findings of this study add to what components can be optimized in PBL. This reinforces and adds to the findings of previous studies which have explained that PBL is a constructivist learning method that is able to invite students to build their own knowledge actively through the learning process (Vesikivi et al., 2020; Waite, 2020). An example of a constructivist learning environment modelled by Grossman et al. (2019). Apart from being at the school education level, PBL can also be used in higher education classes either online or offline because through PBL students collaborate to construct their own knowledge. PBL is able to encourage students to do CL, disciplined teaching, repetitive teaching, AL, so as to be able to encourage students to be optimally involved in the learning process (Li et al., 2021; Owens & Hite, 2020). This study found two empirical findings from the PBL method, firstly PBL contributes positively to CL, DL, repetitive learning, and AL so as to equip students to achieve academic achievement and equip them with skills in solving complex problems. Second, PBL through these main aspects is able to encourage students to be optimally involved in every learning activity they carry out (Mouton, 2020; Sanchez-Muñoz et al., 2020). The implication of this study is that PBL can be used as an alternative learning method that can be used to proportionally strengthen the role of teachers and students. Teachers at tertiary institutions must also train prospective teacher students to be able to use PBL optimally.

6. Conclusion, limitation, and recommendation

Based on the research results and discussion, the PBL method contributes positively to the main aspects of the proposed learning methods such as CL, DL, repetitive learning, and AL. In addition, PBL has a very important role in optimally involving students so that students get meaningful learning experiences and have the skills needed today. PBL can be used by teachers in various fields of study because it is flexible and contains the main components of learning methods. This research has implications that PBL can be used as an alternative learning method that can be used to proportionally strengthen the role of teachers and students. The researcher recommends a number of things, including future research, it is best if the sample involved is expanded from the aspect of number, area, school level, and teaching field of study. In addition, future research should deepen the data by using qualitative analysis of students and research is also advised to examine aspects of constraints, barriers to implementing PBL and how to overcome them. The researcher also recommends to stakeholders to design general instruction guidelines that can be used by educators in various studies. This study only involved junior and senior high school teachers as research participants, involved teachers from several fields of study, and did not reveal the responses of students who received PBL in their learning process. This study has several limitations, including a sample of teachers who did not involve teachers at tertiary institutions, a limited number of samples, the teachers involved were only limited to one area of the city, and it was not strengthened by qualitative data analysis from students regarding responses after receiving material delivery through PBL.

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