



# Enhancing the Quality of Mathematics Learning through Strengthening Pedagogical Competencies, Effectiveness of Project Based Learning Creativity and Achievement Motivation

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## Abstract

The intensity of systemic linkages and synergy among teachers, students, curriculum, learning materials, media, facilities, and learning systems in producing optimal learning processes and outcomes in accordance with curricular demands defines the quality of learning. The quality of learning is a crucial element related to achieving educational goals. Various educational development reports indicate that the quality of mathematics learning at private vocational schools in Bogor Regency does not meet expectations, both in terms of educational goals and competency demands. Therefore, research is necessary to gather information on variables related to improving the quality of learning. The aim of this research is to implement strategies and methods to enhance the quality of learning by investigating the influence of variables such as pedagogical competence, effectiveness of project-based learning (PjBL), creativity, achievement motivation, and learning quality. This research employs the path analysis method to determine the influence among the studied variables and the SITOREM method for indicator analysis to develop strategies and methods for improving the quality of learning.

**Keywords:** Achievement motivation, SITOREM analysis, Creativity, Effectiveness of project based learning (PjBL), Pedagogical Competency, Quality of Learning.

## 1. Introduction

In the 21<sup>st</sup> century, the key word used to be able to take part in life in this century is competence. This competency means more than just knowledge and skills (Rychen & Salganik, 2003). Rychen & Salganik (2003) further explained that this competency involves the ability to meet complex needs, using various psychosocial resources, including attitudes, knowledge and skills in a particular area, for example communication and language skills.

Analytical competence consists of the ability to think critically (critical thinking), the ability to solve problems (problem solving), formulate a decision (decision making) and research and discovery (research and inquiry). Critical thinking includes analyzing arguments, making inferences, inductive or deductive reasoning, assessing or evaluating, and making decisions (Lai, 2011).

Interpersonal competencies (interpersonal skills) include communication, collaboration, leadership and responsibility. These interpersonal skills are related to the ability of how a person can receive and convey ideas or messages either verbally or in writing, and how a person can collaborate with other people in social life.

The ability to carry out action (ability to execute) consists of initiative (initiative) and independence (self direction), as well as productivity (productivity). To be able to carry out an action of renewal or change that changes something or something that is not good for the better, initiative is needed. Independence, which includes phases of thinking, action control and reflection, is part of a strategy to improve self-quality, while productivity refers to the ability to always produce useful work.

The ability to process information (information processing) includes processing related information involving data/information representation; organization, classification, extraction, filtering, summarization, visualization of information; decryption and interpretation of information; translation and comprehension from and to foreign languages; information evaluation; and distinguishing information that is not useful (Wu, 2013). These abilities include information literacy, media literacy, digital society, information technology operations and concepts.

The ability to change (capacity for change) turns out to be a century-old competency 21<sup>st</sup>. This competency includes creativity/innovation, adaptive learning (learning to learn) and flexibility. With creativity/innovation, someone can do work more efficiently. This efficiency can also be applied to learning, by always adapting and carrying out lessons on how to learn better. These competencies are trained through mathematics subjects. The problem is what kind of mathematics subjects train these competencies? This is related to the statement that competencies can be learned in a favorable learning environment (OECD, 2003).

To meet these standards, it is necessary to choose several appropriate learning strategies. Learning that meets these principles and standards, for example problem-based learning (Apino & Retnawati, 2018; Bukhori & Retnawati, 2018), project-based learning, discovery-based learning which has been proven through research to improve various competencies. The learning carried out should not only emphasize lower order thinking, but also the need to teach higher order thinking (HOTS). This learning is carried out by emphasizing active student participation, and is designed starting from determining learning objectives. Learning flow (learning trajectory) also needs to be taken into consideration when formulating learning objectives (Retnawati, 2017).

Learning objectives are not only used for the learning activities themselves, but also for assessment purposes. Considering that the role of assessment is large and has various benefits, including capturing students' abilities to assess the success of the learning carried out, obtaining input on students' learning strategies (Retnawati, Hadi, Nugraha, Sulistyarningsih, 2017), assessment also needs to receive attention. The components measured are not only lower order thinking, but also measure higher order thinking. This will motivate students to learn many things, including various competencies needed in the 21st century.

Apart from the principles and standards mentioned above, what is very urgent and very important is integrating character education in mathematics education. This integration is important, considering that in this life, there are various values that must be maintained, implemented and/or preserved in social life. Even though some values are included in competence, such as responsibility and independence, other values need to be taken into consideration, for example religious values, humanity, politeness, and others.

Even though there are principles and standards for implementing learning, various challenges are faced in implementing mathematics learning. From a curriculum perspective, Even though it has been socialized since 2013, it turns out that its implementation has not been evenly distributed at all levels of education (Retnawati, 2015). From the educator's perspective, the content of the material in the curriculum is too dense, so teachers are more focused on completing the material. This makes it difficult to implement student-centered learning, because it requires a lot of time (Retnawati, Munadi, Arlin Wibowo, Wulandari, 2017). Teachers' understanding of active learning and also learning that trains HOTS (Jailani & Retnawati), as well as the use of information technology-based media is also still varied and partial, so this is a challenge to achieve the expected competencies.

From the student side, students are not yet accustomed to carrying out learning using various strategies and learning approaches. Students are also not used to working on HOTS questions involving several stages of work (complex questions), let alone looking for alternative ways to do it. Regarding problem solving, students also experience problems with long reading questions (Retnawati, Kartowagiran, Arlinwibowo, Sulistyarningsih, 2017).

In terms of facilities and infrastructure, teachers and students still have difficulty finding books for learning and also learning media that train various competencies, HOTS for example (Jailani & Retnawati, 2016). Likewise with assessments, there needs to be examples of assessment models and examples of questions that measure mathematical abilities that are integrated with various required competencies.

To answer these challenges, various efforts can be taken by several related parties. Related research, both learning, media and its integration with values that train various 21st century competencies in order to equip students to face the challenges of the next decade. The results of this research need to be disseminated widely to society, not only in academic circles. Teacher support for implementing literacy learning in general and also specific literacy, for example mathematical literacy, scientific literacy, financial literacy, and media literacy and integration with character education through various practices is very necessary. Likewise, coaching prospective teachers and continuous teacher professional development which emphasizes continuous competency development. Community support is also needed to work together to improve the quality of human resources.

### *1.1. Quality of Learning*

Based on the opinions and theories presented by Dundon & Wilkinson, (2020), Kaizen et al., (2012), Rabiah, (2019), Poornima M. Charantimath, (2020), Tribus, (2010), Jayawardana, (2017), Nurtanto et al., (2020), Darma et al., (2021), it can be synthesized that the quality of learning is the Quality of Learning is the intensity of the systemic and synergistic relationship between teachers, students, curriculum and learning materials, media, facilities and learning systems in producing optimal learning processes and outcomes in accordance with curricular demands. The indicators of learning quality are as follows: 1). Teacher Activities, 2). Learning Facilities, 3). Classroom Climate, 4). Student Attitudes, and 5). Student's motivation to study

### *1.2. Pedagogical Competency*

Based on the opinions and theories presented by Sudargini & Purwanto, (2020), Jason A. Colquit et.al. (2019), Laura M. Desimone and Daniel Stuckey (2018), Piasta et.all (2008), Sailors and Price ( 2010), Christopher Winch and John Gingell (2010), Mulyasa (2006), Suparian (2011), Suprihatiningrum (2013), Rohman (2009), Ramayulis (2013), and Saryati (2014), it can be synthesized that pedagogical competence is the teacher's ability to manage student learning in the teaching and learning process from planning to evaluation as fulfilling a certain role of the teaching profession. The indicators of learning quality are as follows: 1). Mastering the characteristics of students, 2) the ability to manage learning, 3) Utilization of learning technology, 4) Implementation of evaluation of learning outcomes, and 5) Development of students to actualize their various potentials.

### *1.3. Effectiveness of Project Based Learning (PjBL)*

Based on the opinions and theories presented by Daryanto and Raharjo (2012: 162), Fathurrohman (2016:119), Saefudin (2014:58), Mulyasa (2014:145), Satoto Endar Nayono, et al., (2013:341), and Isriani (2015: 5), it can be synthesized that Project Based Learning or abbreviated as PJBL is a learning model that has the aim of guiding students through a collaborative project that integrates various subjects or curriculum material and gives students the opportunity to explore the material using various means that are meaningful to them. himself, and conduct experiments collaboratively. The indicators of learning quality are as follows: 1). Provides complex problems, 2). Designing a way to create a product/project, 3). Develop a product/project manufacturing schedule, 4).

Product/project investigation, 5). Monitor product/project progress, 6). Presentation of final product/project results, and 7). Documentation of the final product/project results

1.3. Creativity

Based on the opinions and theories presented by McShane and Von Glinov (2018), Makhrus et al., (2022), Sang Hoon Bae et al. (2013), Cropley et al. (2011), Hellriegel and Slocum (2011), AJ Starko (2013), Sawyer, R. K. (2012), Shalley (2015), Trevor Davies (2006), Gillian Bramwell, et all (2010), Gibson, et all ( 2012: 78), Tang, Min (2017), and Rais et al., (2022), it can be synthesized that creativity is the action of a person or group to produce and develop new original ideas so that they can increase their imagination differently from before. . The indicators of learning quality are as follows: 1). Exploring curiosity, 2). Generate new ideas, 3). Develop ideas persistently, 4). Combining ideas into something new, and 5). Take a risk

1.4. Achievement Motivation

Based on the opinions and theories presented by Atmoko and Hidayah, (2014), Purwanto, (2014: 219), Susanto (2018: 35), Mangkunegara (2010: 19-20), Yunus (2005), Tucker, Zayco and Herman, (2007), Awan, Nouren and Naz (2011), and Woolfolk, (2004), it can be synthesized that achievement motivation is motivation that has a goal direction to pursue achievement and develop or demonstrate the high ability of each individual to get grades. and maximum results and have commendable value. The indicators of learning quality are as follows: 1). Self-encouragement in achieving goals, 2). Desire to excel in competition, 3). Orientation towards high professional performance, and 4). Strong passion for getting performance feedback

2. Sitorem

SITOREM is an abbreviation for "Scientific Identification Theory to Conduct Operation Research in Education Management", which can generally be interpreted as a scientific method used to identify variables (theory) to conduct "Operation Research" in the field of Education Management (Soewarto Hardhienata, 2017).

In the context of Correlation and Path Analysis research, SITOREM is used as a method to carry out: 1). Identify the strength of the relationship between the Independent Variable and the Dependent Variable, 2) Analyze the value of the research results for each indicator of the research variable, and 3) Analyze the weight of each indicator for each research variable based on the criteria "Cost, Benefit, Urgency and Importance".

Based on the identification of the strength of the relationship between research variables, and based on the weight of each independent variable indicator that has the greatest contribution, a priority order of indicators that need to be immediately improved and those that need to be maintained can be arranged. arranged. Analysis of the value of the research results for each indicator of the research variable is calculated from the average score of each indicator for each research variable. The average score for each indicator is a reflection of the actual condition of these indicators from the point of view of the research subject.

3. Methods

As explained above, this research aims to find strategies and ways to improve the quality of learning through research on the strength of influence between Quality of Mathematics Learning as the dependent variable and pedagogical competence, effectiveness of project based learning (PjBL), creativity, achievement motivation as independent variables. The research method used is a survey method with a path analysis test approach to test statistical hypotheses and the SITOREM method for indicator analysis to determine optimal solutions for improving the quality of mathematics learning.

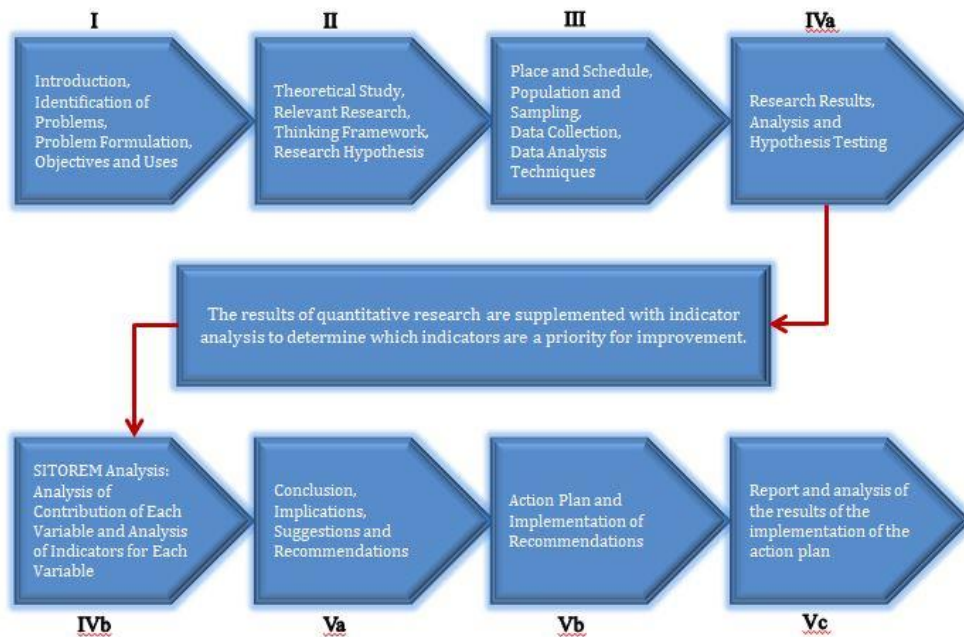
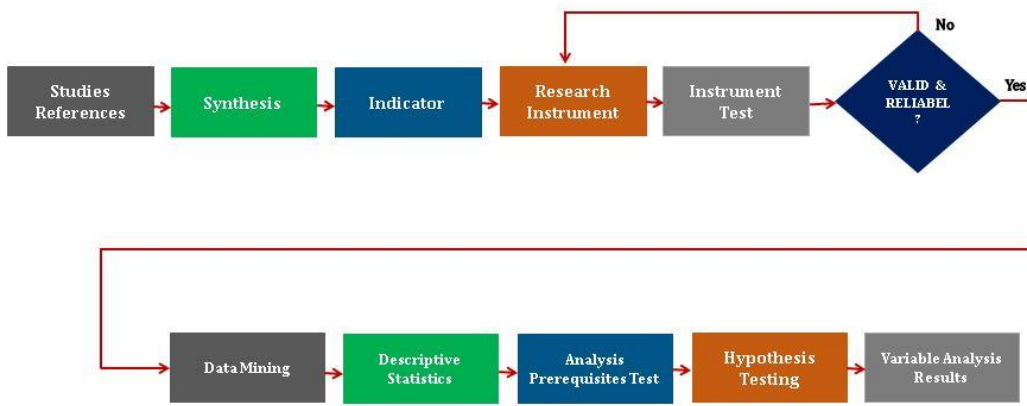


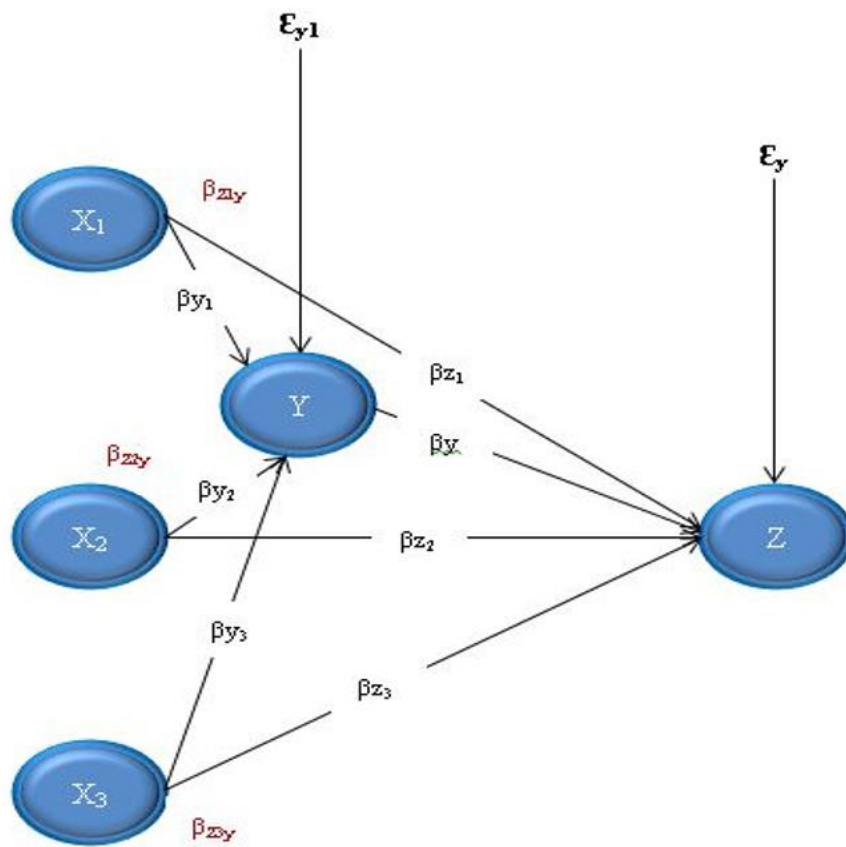
Figure 1. Quantitative and SITOREM Step.



**Figure 2.**  
Quantitative research step.

The research was conducted on foundation permanent teachers (GTY) of Bogor Regency Private Vocational High Schools (SMK) with a teacher population of 289 people, with a sample of 168 teachers calculated using the Slovin formula taken from Umar.

Data collection in this research used a research instrument in the form of a questionnaire which was distributed to teachers as research respondents. The research instrument items come from the research indicators whose conditions will be studied. Before being distributed to respondents, the research instrument was first tested to determine its validity and reliability.



**Figure 3.**  
Research Constellation.

## 4. Result and Discussion

### 4.1. Convergent Validity Test

Evaluation of construct validity is carried out by calculating convergent validity. Convergent validity is known through the loading factor and Average Variance Extracted (AVE) values. An instrument is said to meet the convergent validity test if it has a loading factor and Average Variance Extracted (AVE) above 0.5. The results of convergent validity testing are presented in the following table:



**Table 1.** Convergent validity test results.

Variable	Indicator	Loading factor	AVE
Pedagogical competency (X <sub>1</sub> )	Mastering the characteristics of students	0.846	0.723
	Ability to manage learning	0.868	
	Utilization of learning technology	0.806	
	Implementation of learning outcomes evaluation	0.904	
	Developing students to actualize their various potentials	0.824	
Effectiveness of project based learning (PjBL) (X <sub>2</sub> )	Provides complex problems	0.889	0.771
	Design a way to create a product/project	0.900	
	Prepare a product/project creation schedule	0.775	
	Product/project investigation	0.901	
	Monitor product/Project progress	0.919	
	Presentation of final product/Project results	0.863	
Creativity (X <sub>3</sub> )	Documentation of the final product/Project results	0.892	0.824
	Exploring curiosity	0.916	
	Generate new ideas	0.910	
	Develop ideas persistently	0.939	
	Combining ideas into something new	0.894	
Achievement motivation (Y)	Take a risk	0.880	0.742
	Self-encouragement in achieving goals	0.853	
	Desire to excel in competition	0.906	
	Orientation to high professional performance	0.869	
Learning quality (Z)	Strong passion for getting performance feedback	0.815	0.785
	Teacher activities	0.854	
	Learning facilities	0.919	
	Class climate	0.920	
	Student attitude	0.856	
	Student's motivation to study	0.878	

**4.2. Discriminant Validity Test**

Discriminant validity is calculated using cross loading with the criterion that if the cross loading value in a corresponding variable is greater than the correlation value of the indicator in other variables, then the indicator is declared valid in measuring the corresponding variable. The results of the cross loading calculation are presented in the following table:

**Table 2.** Results of cross loading discriminant validity testing.

Indicator	Pedagogical competency (X <sub>1</sub> )	Effectiveness of project based learning (PjBL) (X <sub>2</sub> )	Creativity (X <sub>3</sub> )	Achievement motivation (Y)	Learning quality (Z)
X1.1	0.846	0.366	0.307	0.498	0.417
X1.2	0.868	0.383	0.357	0.453	0.528
X1.3	0.806	0.369	0.275	0.398	0.462
X1.4	0.904	0.340	0.322	0.483	0.442
X1.5	0.824	0.386	0.330	0.422	0.372
X2.1	0.387	0.889	0.515	0.554	0.580
X2.2	0.390	0.900	0.565	0.536	0.520
X2.3	0.390	0.775	0.449	0.518	0.460
X2.4	0.417	0.901	0.563	0.552	0.578
X2.5	0.341	0.919	0.565	0.494	0.503
X2.6	0.367	0.863	0.477	0.466	0.509
X2.7	0.361	0.892	0.513	0.484	0.497
X3.1	0.385	0.567	0.916	0.564	0.538
X3.2	0.369	0.565	0.910	0.509	0.508
X3.3	0.357	0.548	0.939	0.541	0.521
X3.4	0.307	0.546	0.894	0.522	0.571
X3.5	0.279	0.469	0.880	0.491	0.481
Y.1	0.409	0.505	0.621	0.853	0.536
Y.2	0.460	0.566	0.574	0.906	0.560
Y.3	0.491	0.465	0.444	0.869	0.564
Y.4	0.474	0.486	0.340	0.815	0.518
Z.1	0.445	0.554	0.610	0.621	0.854
Z.2	0.484	0.553	0.537	0.608	0.919
Z.3	0.504	0.547	0.476	0.563	0.920
Z.4	0.455	0.473	0.458	0.448	0.856
Z.5	0.435	0.502	0.462	0.539	0.878

**4.3. Construct Reliability**

Calculations that can be used to test construct reliability are Cronbach alpha and composite reliability. The test criteria state that if the composite reliability is greater than 0.7 and the Cronbach alpha is greater than 0.6 then the construct is declared reliable. The results of composite reliability and Cronbach alpha calculations can be seen through the summary presented in the following table:

**Table 3.** Construct reliability testing results.

Variable	Cronbach's Alpha	Composite Reliability
Pedagogical Competency (X <sub>1</sub> )	0.904	0.929
Effectiveness of Project Based Learning (PjBL) (X <sub>2</sub> )	0.950	0.959
Creativity (X <sub>3</sub> )	0.947	0.959
Achievement Motivation (Y)	0.884	0.920
Learning Quality (Z)	0.931	0.948

**4.4. Coefficient of Determination (R<sup>2</sup>)**

The Determination Coefficient (R<sup>2</sup>) is used to determine the magnitude of the ability of endogenous variables to explain the diversity of exogenous variables, or in other words to determine the magnitude of the contribution of exogenous variables to endogenous variables. The R<sup>2</sup> results can be seen in the following table.

**Table 4.** Results of the coefficient of determination (r<sup>2</sup>).

Variabel Dependen	R Square	R Square Adjusted
Achievement Motivation (Y)	0.498	0.487
Learning Quality (Z)	0.533	0.520

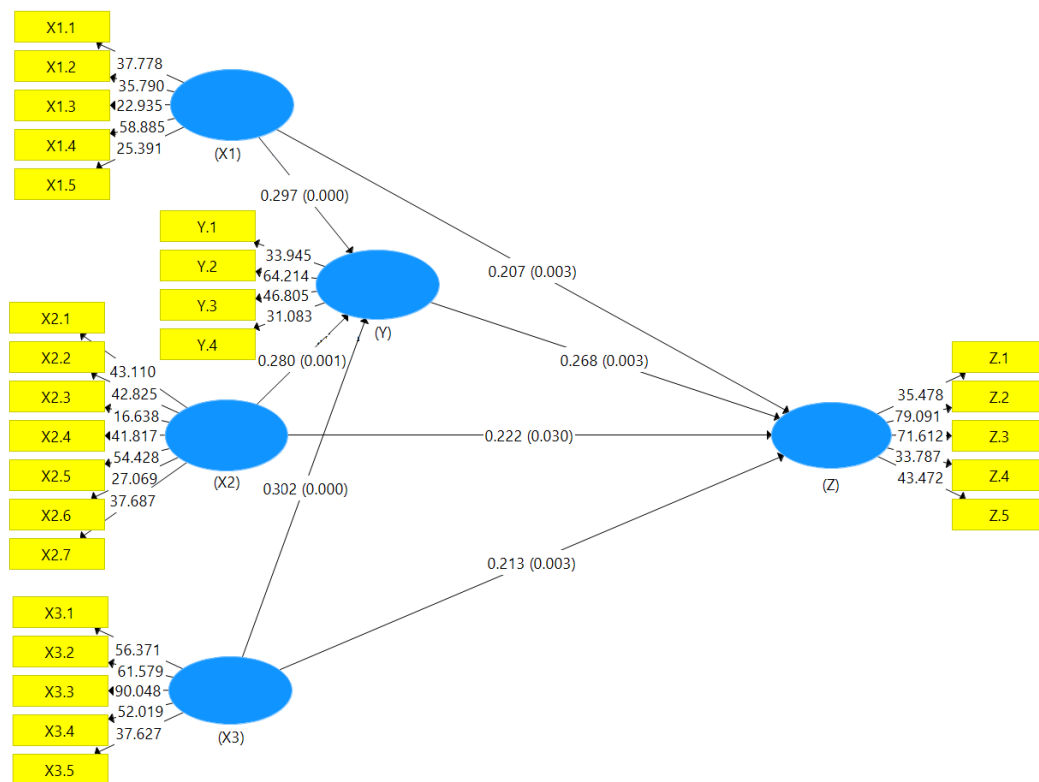
**4.5. Predictive Relevance (Q<sup>2</sup>)**

The Q<sup>2</sup> value can be used to measure how well the observed values are produced by the model and also the estimated parameters. A Q<sup>2</sup> value greater than 0 (zero) indicates that the model is said to be good enough, while a Q<sup>2</sup> value less than 0 (zero) indicates that the model lacks predictive relevance. The following are the results of the Predictive Relevance (Q<sup>2</sup>) test:

**Table 5.** Results of predictive relevance testing (Q<sup>2</sup>).

Variabel Dependen	SSO	SSE	Q <sup>2</sup> (=1-SSE/SSO)
Achievement Motivation (Y)	596.000	384.018	0.356
Learning Quality (Z)	745.000	446.677	0.400

The results in table 5 show that all variables produce Predictive Relevance (Q<sup>2</sup>) values greater than 0 (zero) which indicates that the model is said to be good enough



**Figure 4.** Research constellation.

**4.6. Hypothesis Test**

Significance testing is used to test whether there is an influence of exogenous variables on endogenous variables. The test criteria state that if the T-statistics value is ≥ T-table (1.96) or the P-Value is < significant alpha 5% or 0.05, then it is stated that there is a significant influence of exogenous variables on endogenous variables. The results of significance testing and models can be seen through the following figures and tables.

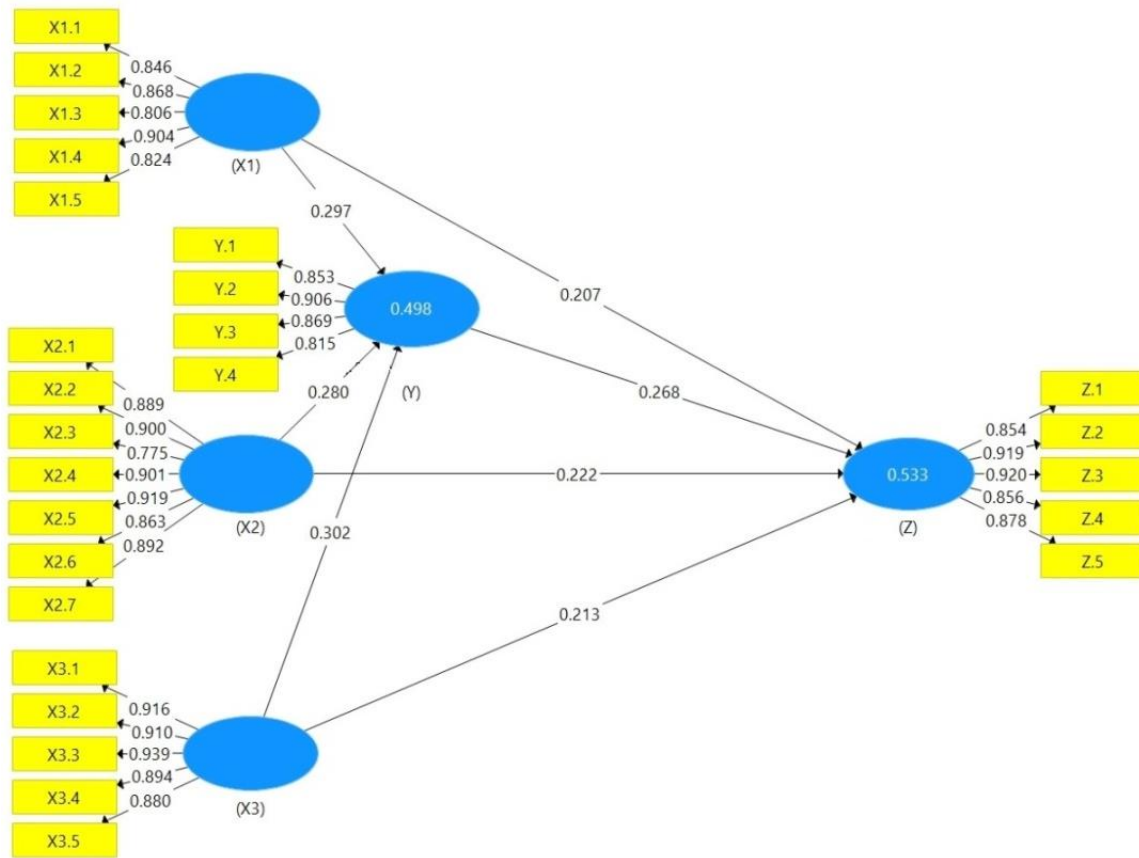


Figure 5. Path analysis results.

Complete hypothesis testing is presented in the following table:

Table 6. Hypothesis testing results.

No.	Path	Coefisien	T Statistics ( O/STDEV )	P Values
1.	Pedagogical Competency (X <sub>1</sub> ) -> Achievement Motivation (Y)	0.297	3.948	0.000
2.	Pedagogical Competency (X <sub>1</sub> ) -> Quality of learning (Z)	0.207	2.957	0.003
3.	Effectiveness of Project Based Learning (PjBL) (X <sub>2</sub> ) -> Achievement Motivation (Y)	0.280	3.310	0.001
4.	Effectiveness of Project Based Learning (PjBL) (X <sub>2</sub> ) -> Quality of learning (Z)	0.222	2.174	0.030
5.	Creativity (X <sub>3</sub> ) -> Achievement Motivation (Y)	0.302	3.818	0.000
6.	Creativity (X <sub>3</sub> ) -> Quality of learning (Z)	0.213	2.985	0.003
7.	Achievement Motivation (Y) -> Quality of learning (Z)	0.268	2.986	0.003

#### 4.7. The Influence of Pedagogical Competency (X<sub>1</sub>) on Achievement Motivation (Y)

Testing the influence of Pedagogical Competency (X<sub>1</sub>) on Achievement Motivation (Y) produces a T statistics value of 3,948 with a p-value of 0.000. The test results show that the T statistics value is > 1.96 and the p-value is < 0.05. This means that there is a significant influence of Pedagogical Competency (X<sub>1</sub>) on Achievement Motivation (Y). The resulting coefficient value is positive, namely 0.297. Thus, it can be interpreted that the higher the Pedagogical Competency (X<sub>1</sub>), the greater the Achievement Motivation (Y).

#### 4.8. Influence of Pedagogical Competency (X<sub>1</sub>) on Learning Quality (Z)

Testing the influence of Pedagogical Competency (X<sub>1</sub>) on Learning Quality (Z) produces a T statistics value of 2.957 with a p-value of 0.003. The test results show that the T statistics value is > 1.96 and the p-value is < 0.05. This means that there is a significant influence of Pedagogical Competency (X<sub>1</sub>) on Learning Quality (Z). The resulting coefficient value is positive, namely 0.207. Thus, it can be interpreted that the higher the Pedagogical Competency (X<sub>1</sub>), the more likely it is to increase the Quality of Learning (Z).

#### 4.9. The Effect of Project Based Learning (PjBL) Effectiveness (X<sub>2</sub>) on Achievement Motivation (Y)

Testing the effect of Project Based Learning (PjBL) Effectiveness (X<sub>2</sub>) on Achievement Motivation (Y) produces a T statistics value of 3.310 with a p-value of 0.001. The test results show that the T statistics value is > 1.96 and the p-value is < 0.05. This means that there is a significant influence of Project Based Learning (PjBL) Effectiveness (X<sub>2</sub>) on Achievement Motivation (Y). The resulting coefficient value is positive, namely 0.280. Thus, it can be interpreted that the better the effectiveness of Project Based Learning (PjBL) (X<sub>2</sub>), the more likely it is to increase Achievement Motivation (Y).

#### 4.10. Effect of Project Based Learning (PjBL) Effectiveness (X<sub>2</sub>) on Learning Quality (Z)

Testing the effect of Project Based Learning (PjBL) Effectiveness (X<sub>2</sub>) on Learning Quality (Z) produces a T statistics value of 2.174 with a p-value of 0.030. The test results show that the T statistics value is > 1.96 and the p-value is < 0.05. This means that there is a significant influence on the effectiveness of Project Based Learning (PjBL) (X<sub>2</sub>) on the Quality of Learning (Z). The resulting coefficient value is positive, namely 0.222. Thus, it can be

interpreted that the better the effectiveness of Project Based Learning (PjBL) ( $X_2$ ), the more likely it is to improve the Quality of Learning (Z).

**4.11. Influence of Creativity ( $X_3$ ) on Achievement Motivation (Y)**

Testing the influence of Creativity ( $X_3$ ) on Achievement Motivation (Y) produces a T statistics value of 3,818 with a p-value of 0.000. The test results show that the T statistics value is  $> 1.96$  and the p-value is  $< 0.05$ . This means that there is a significant influence of Creativity ( $X_3$ ) on Achievement Motivation (Y). The resulting coefficient value is positive, namely 0.302. Thus, it can be interpreted that the better Creativity ( $X_3$ ) tends to increase Achievement Motivation (Y).

**4.12. Influence of Personality ( $X_3$ ) on Learning Quality (Z)**

Testing the effect of Creativity ( $X_3$ ) on Learning Quality (Z) produces a T statistics value of 2.986 with a p-value of 0.003. The test results show that the T statistics value is  $> 1.96$  and the p-value is  $< 0.05$ . This means that there is a significant influence of Creativity ( $X_3$ ) on Learning Quality (Z). The resulting coefficient value is positive, namely 0.213. Thus, it can be interpreted that the better the Creativity ( $X_3$ ), the more likely it is to improve the Quality of Learning (Z).

**4.13. Influence of Achievement Motivation (Y) on Learning Quality (Z)**

Testing the effect of Achievement Motivation (Y) on Learning Quality (Z) produces a T statistics value of 2.986 with a p-value of 0.003. The test results show that the T statistics value is  $> 1.96$  and the p-value is  $< 0.05$ . This means that there is a significant influence of Achievement Motivation (Y) on Learning Quality (Z). The resulting coefficient value is positive, namely 0.268. Thus, it can be interpreted that the higher the Achievement Motivation (Y), the more likely it is to increase the Quality of Learning (Z).

**Table 7.** Indirect effect hypothesis testing.

No	Variabel Indirect	Coefisien	T Statistics ( O/STDEV )	P Values
1.	Pedagogical Competency ( $X_1$ ) -> Achievement Motivation (Y) -> Quality of learning (Z)	0.080	2.250	0.025
2.	Effectiveness of Project Based Learning (PjBL) ( $X_2$ ) -> Achievement Motivation (Y) -> Quality of learning (Z)	0.075	2.203	0.028
3.	Creativity ( $X_3$ ) -> Achievement Motivation (Y) -> Quality of learning (Z)	0.081	2.442	0.015

**4.14. The Influence of Pedagogical Competency ( $X_1$ ) on Learning Quality (Z) Through Achievement Motivation (Y)**

Testing the influence of Pedagogical Competency ( $X_1$ ) on Learning Quality (Z) through Achievement Motivation (Y) produces a T statistics value of 2.250 with a p-value of 0.025. The test results show that the T statistics value is  $> 1.96$  and the p-value is  $< 0.05$ . This means that there is a significant influence of Pedagogical Competency ( $X_1$ ) on Learning Quality (Z) through Achievement Motivation (Y). Thus, it can be stated that Achievement Motivation (Y) is able to mediate the influence of Pedagogical Competency ( $X_1$ ) on Learning Quality (Z).

**4.15. The Effect of Project Based Learning (PjBL) Effectiveness ( $X_2$ ) on Learning Quality (Z) Through Achievement Motivation (Y)**

Testing the effect of the Effectiveness of Project Based Learning (PjBL) ( $X_2$ ) on the Quality of Learning (Z) through Achievement Motivation (Y) produces a T statistics value of 2.203 with a p-value of 0.028. The test results show that the T statistics value is  $> 1.96$  and the p-value is  $< 0.05$ . This means that there is a significant influence on the effectiveness of Project Based Learning (PjBL) ( $X_2$ ) on the Quality of Learning (Z) through Achievement Motivation (Y). Thus, it can be stated that Achievement Motivation (Y) is able to mediate the influence of Project Based Learning (PjBL) Effectiveness ( $X_2$ ) on Learning Quality (Z).

**4.16. The Influence of Creativity ( $X_3$ ) on Learning Quality (Z) Through Achievement Motivation (Y)**

Testing the influence of Creativity ( $X_3$ ) on Learning Quality (Z) through Achievement Motivation (Y) produces a T statistics value of 2.442 with a p-value of 0.015. The test results show that the T statistics value is  $> 1.96$  and the p-value is  $< 0.05$ . This means that there is a significant influence of Creativity ( $X_3$ ) on Learning Quality (Z) through Achievement Motivation (Y). Thus it can be stated that Achievement Motivation (Y) is able to mediate the influence of Creativity ( $X_3$ ) on Learning Quality (Z).

**4.17. Optimal Solution for Improving Learning Quality**

Based on the results of statistical hypothesis testing, determining indicator priorities, and calculating indicator values as described above, a recapitulation of research results can be made which is the optimal solution for improving the Quality of Learning as follows:



Table 8. SITOREM analysis.

Pedagogical Competency ( $\beta z1 = 0,207$ ) (rangk.IV)				
Indicator in Initial State		Indicator after Weighting by Expert		Indicator Value
1	Mastering the characteristics of students	1 <sup>st</sup>	Mastering student characteristics (21.17)	3.88
2	Ability to manage learning	2 <sup>nd</sup>	Implementation of learning outcomes evaluation (21.13)	4.10
3	Utilization of Learning Technology	3 <sup>rd</sup>	Utilization of Learning Technology (20.16)	4.00
4	Implementation of learning outcomes evaluation	4 <sup>th</sup>	Ability to manage learning (20.17)	3.61
5	Developing students to actualize their various potentials	5 <sup>th</sup>	Development of students to actualize their various potentials (17.37)	3.60
Effectiveness of Project Based Learning (PjBL) ( $\beta z2 = 0,222$ ) (rangk.II)				
Indicator in Initial State		Indicator after Weighting by Expert		Indicator Value
1	Provides complex problems	1 <sup>st</sup>	Designing a way to create a product/project (16.18)	3.57
2	Design a way to create a product/project	2 <sup>nd</sup>	Develop a product/project creation schedule (16.13)	4.02
3	Prepare a product/project creation schedule	3 <sup>rd</sup>	Presentation of final product/project results (15.16)	3.68
4	Product/project investigation	4 <sup>th</sup>	Monitor product/project progress (15.04)	4.04
5	Monitor product/project progress	5 <sup>th</sup>	Product/project investigation (13.16)	4.12
6	Presentation of final product/project results	6 <sup>th</sup>	Provides complex problems (13.12)	4.08
7	Documentation of the final product/project results	7 <sup>th</sup>	Documentation of final product/project results (11.21)	3.74
Creativity ( $\beta z3 = 0,213$ ) (rangk.III)				
Indicator in Initial State		Indicator after Weighting by Expert		Indicator Value
1	Exploring curiosity	1 <sup>st</sup>	Taking risks (20.38)	3.82
2	Generate new ideas	2 <sup>nd</sup>	Combining ideas into something new (20.16)	3.84
3	Develop ideas persistently	3 <sup>rd</sup>	Developing ideas persistently (20.13)	3.78
4	Combining ideas into something new	4 <sup>th</sup>	Generating new ideas (20.12)	4.14
5	Take a risk	5 <sup>th</sup>	Exploring curiosity (19.21)	4.02
Achievement Motivation ( $\beta y1 = 0,268$ ) (rank. I)				
Indicator in Initial State		Indicator after Weighting by Expert		Indicator Value
1	Self-encouragement in achieving goals	1 <sup>st</sup>	Desire to excel in competition (26.37)	3.85
2	Desire to excel in competition	2 <sup>nd</sup>	Self-encouragement in achieving goals (25.43)	4.11
3	Orientation to high professional performance	3 <sup>rd</sup>	Orientation to high professional performance (24.56)	3.65
4	Strong passion for getting performance feedback	4 <sup>th</sup>	Strong passion for getting performance feedback (23.64)	4.03
Quality Learning				
Indicator in Initial State		Indicator after Weighting by Expert		Indicator Value
1	Teacher Activities	1 <sup>st</sup>	Classroom Climate (21.17)	3.78
2	Learning Facilities	2 <sup>nd</sup>	Learning Facilities (21.13)	3.65
3	Class Climate	3 <sup>rd</sup>	Student Attitude (20.16)	4.15
4	Student Attitude	4 <sup>th</sup>	Student Learning Motivation (19.12)	3.86
5	Student's motivation to study	5 <sup>th</sup>	Teacher Activities (18.42)	4.16
Sitorem Analysis Result				
Priority order of indicator to be Strengthened		Indicator remain to be maintained		
1 <sup>st</sup>	Desire to excel in competition	1. Self-encouragement in achieving goals		
2 <sup>nd</sup>	Orientation to high professional performance	2. Strong passion for performance feedback		
3 <sup>rd</sup>	Design a way to create a product/project	3. Develop a product/project creation schedule		
4 <sup>th</sup>	Presentation of final product/project results	4. Monitor product/project progress		
5 <sup>th</sup>	Documentation of the final product/project results	5. Product/project investigation		
6 <sup>th</sup>	Take a risk	6. Provide complex problems		
7 <sup>th</sup>	Combining ideas into something new	7. Generate new ideas		
8 <sup>th</sup>	Develop ideas persistently	8. Explore curiosity		
9 <sup>th</sup>	Mastering the characteristics of students	9. Implementation of learning outcomes evaluation		
10 <sup>th</sup>	Ability to manage learning	10. Use of Learning Technology		
11 <sup>th</sup>	Developing students to actualize their various potentials	11. Student Attitude		
12 <sup>th</sup>	Class Climate	12. Teacher Activities		
13 <sup>th</sup>	Learning Facilities			
14 <sup>th</sup>	Student's motivation to study			

### 5. Conclusions, Implications and Suggestions

Based on the results of the analysis, discussion of research results and hypotheses that have been tested, it can be concluded as follows:

1. Improving the Quality of Learning can be done by using strategies to strengthen variables that have a positive influence on the Quality of Learning.

2. Variables that have a positive influence on the Quality of Learning are Pedagogical Competency, Effectiveness of Project Based Learning (PjBL), Creativity, and Achievement Motivation. This is proven by the results of variable analysis using the SEM PLS method.

3. The way to improve the quality of learning is to improve weak indicators and maintain good indicators for each research variable.

Based on the research conclusions above, the following implications can be drawn from this research:

1. In order to improve the quality of learning, it is necessary to strengthen Pedagogical Competency, Effectiveness of Project Based Learning (PjBL), and Creativity, as exogenous variables with Achievement Motivation as an intervening variable.

2. If Pedagogical Competency is to be developed, it is necessary to improve the indicators that are still weak, namely: Mastering the characteristics of students, Ability to manage learning, and Development of students to actualize the various potentials they have and maintain or develop indicators: Implementation of evaluation of learning outcomes and Utilization of Learning Technology.

3. If the effectiveness of Project Based Learning (PjBL) is to be developed, it is necessary to improve the indicators that are still weak, namely, Designing ways to create products/projects, Presentation of final product/project results, and Documentation of final product/project results, as well as maintaining or developing indicators: Developing product/project manufacturing schedules, Monitoring product/project progress, Investigating products/projects, and Providing complex problems

4. If creativity is to be developed, it is necessary to improve the indicators that are still weak, namely: Taking risks, Combining ideas into something new, and Developing ideas persistently, as well as maintaining or developing the indicators: Generating new ideas, and Exploring curiosity

5. To increase Achievement Motivation, it is necessary to improve indicators that are still weak, namely the desire to excel in competition, and orientation towards high professional performance, as well as maintaining or developing indicators: Self-drive in achieving goals, and a strong passion for get performance feedback

Suggestions or recommendations that can be given to related parties are as follows:

1. Principals need to improve the quality of learning by strengthening Pedagogical Competency, Effectiveness of Project Based Learning (PjBL), Creativity, and Achievement Motivation by improving: Class Climate, Learning Facilities, and Student Learning Motivation as well as maintaining or developing Student Attitudes and Teacher Activities

2. The Ministry of Education, Culture, Research and Technology (Kemdikbudristek) and school organizing institutions need to develop teachers to improve the Quality of Learning by providing appropriate direction to strengthen the strengthening of Pedagogical Competency, Effectiveness of Project Based Learning (PjBL), Creativity and Achievement Motivation in accordance with the results of this research.

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