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SYNERGY OF PEDAGOGICAL COMPETENCE, EFFECTIVENESS OF PJBL, CREATIVITY, AND ACHIEVEMENT MOTIVATION: A STRATEGY TO IMPROVE THE QUALITY OF MATHEMATICS LEARNING

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ABSTRACT

The intensity of the systemic interrelationships and synergy between teachers, students, curriculum and learning materials, media, facilities, and learning systems in producing optimal learning processes and outcomes in accordance with curricular demands is what is meant by learning quality. Learning quality is a crucial element related to achieving educational goals. Various reports on educational developments indicate that the quality of Mathematics learning in private vocational schools in Bogor Regency has not met expectations, both in terms of educational goals and competency requirements. Therefore, research is needed to obtain information on variables related to improving learning quality. The purpose of this study is to develop strategies and methods for improving learning quality by examining the influence between pedagogical competency variables, project-based learning (PjBL) effectiveness, creativity, achievement motivation, and learning quality. This study uses path analysis to determine the influence between the variables studied and the SITOREM method for indicator analysis to obtain strategies and methods for improving learning quality.

KEYWORDS: Learning Quality, Pedagogical Competence, Effectiveness of Project Based Learning (PjBL), Creativity, Achievement Motivation, SITOREM Analysis.

1.0 INTRODUCTION

In the 21st century, the key word used to participate in life in this century is competence. This competence means more than just knowledge and skills (Rychen & Salganik, 2003). Rychen & Salganik (2003) further explain that this competence involves the ability to meet complex needs, using a variety of psychosocial resources, including attitudes, knowledge, and skills in a specific area, such as communication and language skills.

Quality mathematics learning is not simply about adding numbers or solving formulas, but rather building a foundation of logical, systematic, and critical thinking that forms the basis of students' intellectual abilities. In a global landscape characterized by complexity, uncertainty, and rapid change (VUCA), mastery of mathematics is no longer an optional skill, but a strategic imperative to foster numerical literacy, problem-solving, and innovation.

Mathematics has a transformative role in developing abstract reasoning, the ability to generalize, and fostering metacognition—the ability to think about one's own thinking. Good quality mathematics learning will shape students who don't simply memorize formulas, but understand concepts, are able to apply them in real-life situations, and possess the intellectual courage to explore alternative solutions.

According to international assessments such as the Programme for International Student Assessment (PISA), Indonesian students' performance in mathematical literacy remains relatively low. This indicates a gap between curriculum demands and the reality of the learning process. The low quality of mathematics learning can stem from traditional pedagogical approaches, minimal technology integration, a lack of real-life application contexts, and teachers' underdeveloped competencies in innovative and contextual methods.

In many classrooms in Indonesia, mathematics learning remains an unresolved challenge. Mathematics, a universal language for practicing logic, fostering analytical skills, and developing problem-solving skills, often feels disconnected from students' real-life situations. PISA 2022 data paints a worrying picture: only around 18% of Indonesian students achieve the minimum proficiency level, while the OECD average is 69%. Indonesian students' average math score lags behind, at 366 points, far below the international standard of 472. This situation illustrates a significant gap—not only in calculation ability but also in critical thinking skills, which are crucial in the digital age.

Ideally, mathematics classes in Indonesia should be vibrant spaces, where students can interpret everyday phenomena mathematically, build models to solve complex problems, and confidently communicate their solutions. There, learning is no longer limited to memorizing formulas but develops into challenging and relevant experiences, guided by teachers who master creative pedagogy and utilize learning technology. The journey towards this ideal state is indeed long, but every step of improvement—from curriculum updates, teacher competency enhancements, to method innovations such as project-based learning—will bring us closer to the ideal of mathematics education that is capable of producing a superior and globally competitive generation.

Quality mathematics learning also directly contributes to the achievement of 21st-century competencies, such as critical thinking, creativity, collaboration, and communication. When students are presented with contextual and meaningful mathematical challenges, they learn to solve problems collaboratively, explain logical reasoning, and present data argumentatively—all essential skills in the future workforce.

For teachers, the quality of mathematics learning encompasses several aspects: planning based on the curriculum and student needs, the selection of active and participatory learning methods (e.g., problem-based learning or realistic mathematics education), the use of manipulative tools and technology, and assessments that measure the thinking process, not just the final product. Furthermore, the quality of mathematics learning is also an indicator of the quality of educational institutions. Schools that successfully develop strong mathematics programs tend to produce graduates who are better prepared to face the challenges of science, technology, the digital economy, and entrepreneurship.

Therefore, improving the quality of mathematics learning is a strategic investment in human resource development. This is not a one-person task, but collaboration between teachers, principals, policymakers, and the wider community. Only with quality mathematics learning can we develop a generation that is not merely "able to count" but also thinks intelligently, wisely, and provides solutions.

Analytical competencies consist of critical thinking, problem-solving, decision-making, and research and inquiry. Critical thinking includes analyzing arguments, drawing inferences, reasoning inductively and deductively, assessing or evaluating, and making decisions (Lai, 2011).

Interpersonal skills include communication, collaboration, and leadership and responsibility. These interpersonal skills relate to the ability to receive and convey ideas or messages, both verbally and in writing, and how to work with others in social life.

The ability to execute consists of initiative and self-direction, as well as productivity. To be able to carry out renewal or change that transforms something from bad to better, initiative is required. Independence, which encompasses the stages of thinking, action control, and reflection, is part of a strategy for improving self-quality, while productivity refers to the ability to consistently produce useful work.

Information processing skills encompass processing related information, involving data/information representation; organization, classification, extraction, filtering, summarization, and visualization of information; decryption and interpretation of information; translation and comprehension from and to foreign languages; evaluation of information; and distinguishing between useless and irrelevant information (Wu, 2013). These skills encompass information literacy, media literacy, digital society, and information technology operations and concepts.

The capacity for change has proven to be a 21st-century competency. This competency encompasses creativity/innovation, adaptive learning (learning to learn), and flexibility. With creativity and innovation, a person can perform work more efficiently. This efficiency can also be applied to learning, by continually adapting and implementing learning strategies to improve learning. These competencies are practiced through mathematics. The question is, what kind of mathematics subjects train these competencies? This relates to the statement that competencies can be learned in a conducive learning environment (OECD, 2003).

To meet these standards, several appropriate learning strategies must be selected. Learning that meets these principles and standards includes problem-based learning (Apino & Retnawati, 2018; Bukhori & Retnawati, 2018), project-based learning, and discovery-based learning, which have been proven through research to improve various competencies. The learning conducted should not only emphasize lower-order thinking but also the need to teach higher-order thinking (HOTS). This learning is implemented by emphasizing active student participation and is designed starting from the determination of learning objectives. The learning trajectory also needs to be considered when formulating learning objectives (Retnawati, 2017).

Learning objectives are not only used for learning activities themselves, but also for assessment purposes. Given the significant role of assessment and its numerous benefits, including capturing students' ability to assess the success of their learning and providing input on their learning strategies (Retnawati, Hadi, Nugraha, Sulistyaningsih, 2017), assessment also requires attention. The components measured should not only measure lower-order thinking but also higher-order thinking. This will motivate students to learn a wide range of things, including the various competencies needed in the 21st century.

In addition to the principles and standards mentioned above, integrating character education into mathematics education is crucial. This integration is crucial, given that in life, various values must be maintained, implemented, and/or preserved in society. While some values are already included in competencies, such as responsibility and independence, others require attention, such as religious values, humanity, politeness, and others.

Despite the existence of principles and standards for learning, various challenges are faced in implementing mathematics. In terms of the curriculum, although it has been socialized since 2013, its implementation has not been evenly distributed across all levels of education (Retnawati, 2015). From the educators' perspective, the curriculum is too dense, forcing teachers to focus on completing the material. This makes it difficult to implement student-centered learning, as it requires a significant amount of time (Retnawati, Munadi, Arlin Wibowo, Wulandari, 2017). Teachers' understanding of active learning and HOTS (Hospital Values) learning (Jailani & Retnawati), as well as the use of information technology-based media, remains varied and partial, posing a challenge to achieving the desired competencies.

From a student perspective, they are not yet accustomed to implementing learning using various strategies and approaches. They are also not accustomed to working on HOTS questions that involve multiple stages (complex questions), let alone finding alternative methods to solve them. Regarding problem-solving, students also encounter problems with long reading passages (Retnawati, Kartowagiran, Arlinwibowo, Sulistyaningsih, 2017).

In terms of facilities and infrastructure, teachers and students still struggle to find textbooks and learning media that practice various competencies, such as HOTS (Jailani & Retnawati, 2016). Similarly, assessments require examples of assessment models and sample questions that measure mathematical abilities integrated with the various required competencies.

To address these challenges, various efforts can be undertaken by various stakeholders. Related research, including learning, media, and their integration with values, trains various 21st-century competencies to prepare students for the challenges of the coming decade. The results of this research need to be disseminated widely to the public, not just within academic circles. Teacher support in implementing literacy learning in general and specific areas, such as mathematics, science, financial literacy, and media literacy, and integrating them with character education through various habituation programs, is essential. Likewise, the development of prospective teachers and ongoing teacher professional development, which emphasizes continuous competency development, are crucial. Community support is also needed to collectively strive to improve the quality of human resources.

1) **Learning Quality**
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), and Darma et al. (2021), it can be summarized that learning quality is the intensity of the systemic and synergistic relationships 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 Learning Motivation

2) **Pedagogical Competence**
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 al. (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 summarized that pedagogical competence is a teacher's ability to manage student learning in the teaching-learning process, from planning to evaluation, as a fulfillment of the specific role of the teaching profession. The indicators of learning quality are as follows: 1). Mastering student characteristics, 2) learning management skills, 3) utilizing learning technology, 4) implementing learning outcome evaluations, and 5) developing students to actualize their various potentials.

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), SatotoEndarNayono et al. (2013: 341), and Isriani (2015: 5), it can be summarized that Project-Based Learning, or PJBL, is a learning model that aims to guide students through collaborative projects that integrate various curriculum subjects or materials and provide opportunities for students to explore the material in various meaningful ways and conduct collaborative experiments. The

indicators of learning quality are as follows: 1) Providing complex problems, 2) Designing a method for creating a product/project, 3). Developing a product/project creation schedule, 4). Investigating the product/project, 5). Monitoring the progress of the product/project, 6). Presenting the final results of the product/project, and 7). Documenting the final results of the product/project

4) Creativity

Based on the opinions and theories presented by McShane and Von Glinov (2018), Makhrus et al. (2022), Sang HoonBae et al. (2013), Cropley et al. (2011), Hellriegel and Slocum (2011), A.J. Starko (2013), Sawyer, R. K. (2012), Shalley (2015), Trevor Davies (2006), Gillian Bramwell et al. (2010), Gibson et al. (2012: 78), Tang, Min (2017), and Rais et al. (2022), it can be summarized that creativity is the act of an individual or group to generate and develop new, original ideas that can enhance imagination, unlike before. The indicators of learning quality are as follows: 1) Exploring curiosity, 2) Generating new ideas, 3) Developing ideas persistently, 4) Combining ideas into something new, and 5) Taking risks.

5) 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 summarized that achievement motivation is a goal-directed motivation to pursue achievement and develop or demonstrate high individual abilities to achieve maximum and commendable values and results. The indicators of learning quality are as follows: 1) Self-drive in achieving goals, 2) Desire to excel in competition, 3) Orientation toward high professional performance, and 4) Strong desire to receive performance feedback.

6) SITOREM

SITOREM is an abbreviation for "Scientific Identification Theory to Conduct Operation Research in Education Management," which can generally be defined as a scientific method used to identify variables (theories) for conducting "Operation Research" in the field of Educational Management (SoewartoHardhienata, 2017).

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

Based on the identification of the strength of the relationship between research variables and the weight of each independent variable indicator with the greatest contribution, a priority order can be established for indicators that need immediate improvement and those that need to be maintained. The analysis of the research result value for each research variable indicator is calculated from the average score of each indicator for each research variable. The average score for each indicator reflects the actual condition of these indicators from the perspective of the research subjects.

2.0 METHODS

As explained above, this study aims to find strategies and ways to improve the quality of learning through research on the strength of the influence between the Quality of Mathematics Learning as the dependent variable and pedagogical competence, the effectiveness of project-based learning (PjBL), creativity, and 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.

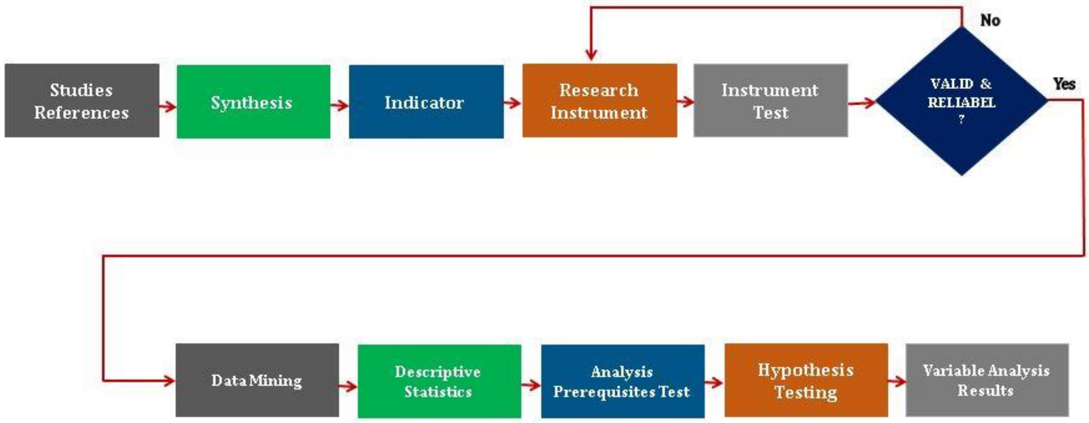

Figure 1. Quantitative Research Flow

The study was conducted on permanent foundation teachers (GTY) at private vocational high schools (SMK) in Bogor Regency, with a population of 289 teachers, and a sample of 168 teachers calculated using the Slovin formula adopted from Umar.

Data collection in this study utilized a questionnaire distributed to teachers as respondents. The instrument items were derived from the research indicators whose conditions would be examined. Before being distributed to respondents, the instrument was pre-tested to determine its validity and reliability

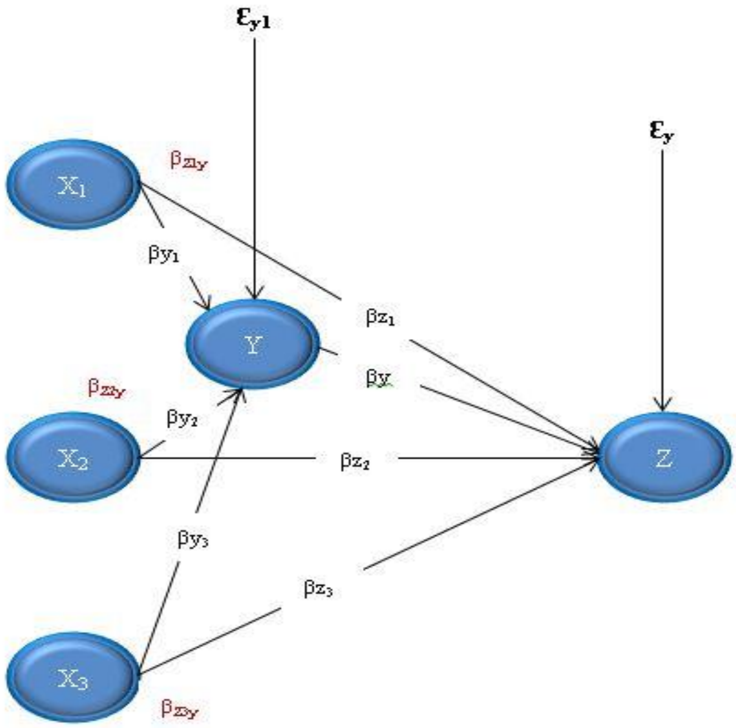

Figure 2. Research Constellation

3.0 RESULT AND DISCUSSION

3.1 Convergen Validity Test

Construct validity is evaluated by calculating convergent validity. Convergent validity is determined by factor loading and Average Variance Extracted (AVE) values. An instrument is considered to meet convergent validity if its factor loading and Average Variance Extracted (AVE) values are above 0.5. The results of the convergent validity test are presented in the following table:

Table 1. Convergent Validity Test Results

Variable	Indicator	Loading Faktor	AVE
Pedagogical Competence (X_1)	Mastering student characteristics	0.846	0.723
	Ability to manage learning	0.868	
	Utilization of learning technology	0.806	
	Implementing evaluation of learning outcomes	0.904	
	Developing students to actualize their various potentials	0.824	
Effectiveness of Project Based learning (PjBL) (X_2)	Presenting a complex problem	0.889	0.771
	Designing a method for creating the product/project	0.900	
	Developing a product/project creation schedule	0.775	
	Product/project investigation	0.901	
	Monitoring product/project progress	0.919	
	Presenting final product/project results	0.863	
	Documenting final product/project results	0.892	

Variable	Indicator	Loading Faktor	AVE
Creativity (X_3)	Exploring curiosity	0.916	0.824
	Generating new ideas	0.910	
	Developing ideas persistently	0.939	
	Combining ideas into something new	0.894	
	Taking risks	0.880	
Achievement Motivation (Y)	Self-drive to achieve goals	0.853	0.742
	Desire to excel in competition	0.906	
	Orientation toward high professional performance	0.869	
	Strong desire for performance feedback	0.815	
Quality of Learning (Z)	Teacher Activities	0.854	0.785
	Learning Facilities	0.919	
	Classroom Climate	0.920	
	Student Attitudes	0.856	
	Student Learning Motivation	0.878	

3.2 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 another variable, then the indicator is considered 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 Test

Indikator	Pedagogical Competence (X_1)	Effectiveness of Project Based learning (PjBL)(X_2)	Creativity (X_3)	Achievement Motivation (Y)	Quality of Learning (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**	0.44	0.518	0.460

Indikator	Pedagogical Competence (X_1)	Effectiveness of Project Based learning (PjBL)(X_2)	Creativity (X_3)	Achievement Motivation (Y)	Quality of Learning (Z)
			9		
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**

3.3 Construct Reliability

The calculations that can be used to test construct reliability are Cronbach's alpha and composite reliability. The testing criteria state that if the composite reliability is greater than 0.7 and the Cronbach's alpha is greater than 0.6, the construct is considered reliable. The results of the composite reliability and Cronbach's alpha calculations can be summarized in the following table:

Table 3. Construct Reliability Test Results

Variable	*Cronbach's Alpha*	*Composite Reliability*
Pedagogical Competence (X_1)	0.904	0.929
Effectiveness of Project Based learning (PjBL) (X_2)	0.950	0.959
Creativity (X_3)	0.947	0.959
Achievement Motivation (Y)	0.884	0.920
Quality of Learning (Z)	0.931	0.948

3.4 Coefisien Determinasi (R^2)

The coefficient of determination (R^2) is used to determine the extent to which endogenous variables can explain the variability of exogenous variables, or in other words, to determine the extent of the exogenous variable's contribution to the endogenous variable. The R^2 results can be seen in the following table.

Table 4. Results of the Coefficient of Determination (R^2)

Dependent Variable	R Square	R Square Adjusted
Achievement Motivation (Y)	0.498	0.487
Quality of Learning (Z)	0.533	0.520

3.5 Predictive Relevance (Q^2)

The Q^2 value can be used to measure how well the observed values generated by the model and its parameter estimates are matched. A Q^2 value greater than 0 (zero) indicates that the model is considered adequate, while a Q^2 value less than 0 (zero) indicates that the model lacks predictive relevance. The following are the results of the Predictive Relevance (Q^2) test:

Table 5. Predictive Relevance (Q^2) Test Results

Dependent Variable	SSO	SSE	Q^2 (=1-SSE/SSO)
Achievement Motivation (Y)	596.000	384.018	0.356
Quality of Learning (Z)	745.000	446.677	0.400

The results in table 5 show that all variables produce a Predictive Relevance (Q^2) value greater than 0 (zero), which indicates that the model is said to be quite good.

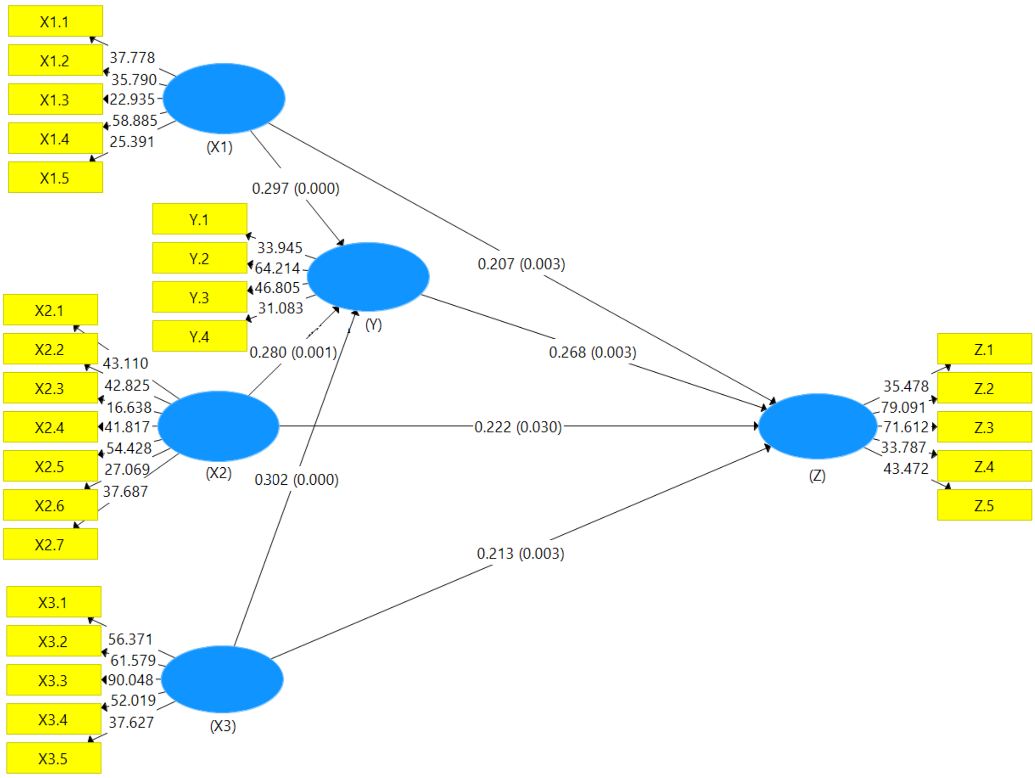

Figure 3. Research Constellation

3.6 Hypothesis Testing

Significance testing is used to determine whether exogenous variables influence endogenous variables. The test criteria state that if the T-statistic value is greater than the T-table (1.96) or the P-value is less than a significant alpha of 5% or 0.05, then a significant influence of the exogenous variables on the endogenous variables is confirmed. The results of the significance test and the model can be seen in the following figure and table.

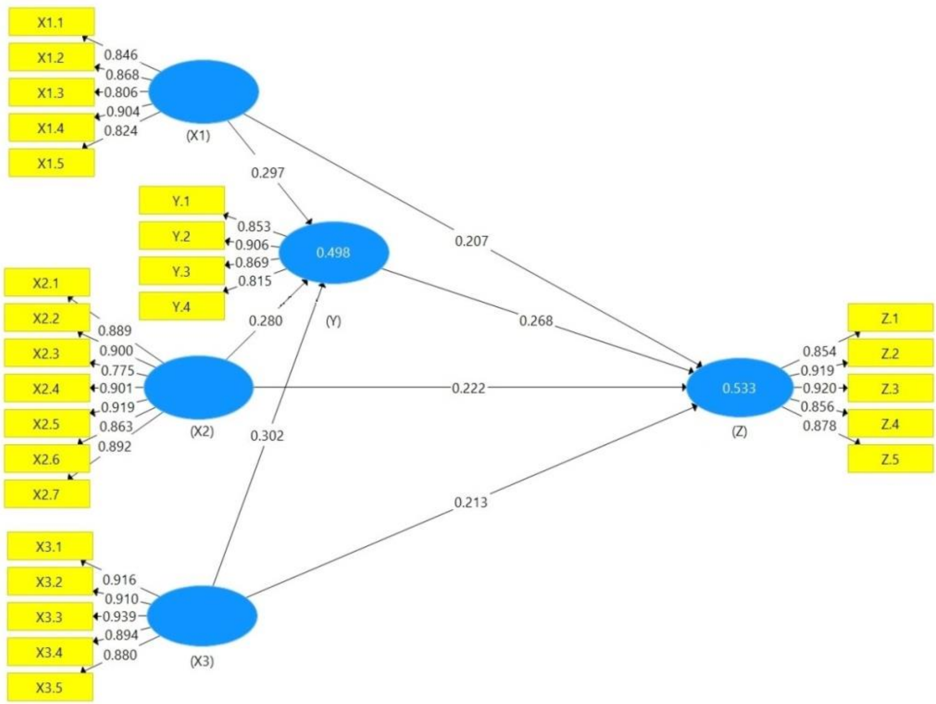

Figure 4. Influence between Variables

The complete hypothesis testing is presented in the following table:

Table 6. Hypothesis Test Results

No.	Influence	Coefisien	T Statistics (|O/STDEV|)	P Values
1.	Pedagogical Competence (X1) → Achievement Motivation (Y)	0.297	3.948	0.000
2.	Pedagogical Competence (X1) → Learning Quality (Z)	0.207	2.957	0.003
3.	Project-Based Learning (PjBL) Effectiveness (X2) → Achievement Motivation (Y)	0.280	3.310	0.001
4.	Project-Based Learning (PjBL) Effectiveness (X2) → Learning Quality (Z)	0.222	2.174	0.030
5.	Creativity (X3) → Achievement Motivation (Y)	0.302	3.818	0.000
6.	Creativity (X3) → Learning Quality (Z)	0.213	2.985	0.003
7.	Achievement Motivation (Y) → Learning Quality (Z)	0.268	2.986	0.003

1) **The Effect of Pedagogical Competence (X1) on Achievement Motivation (Y)**
The test of the effect of Pedagogical Competence (X1) on Achievement Motivation (Y) yielded a T-statistic of 3.948 with a p-value of 0.000. The test results indicated that the T-statistic > 1.96 and the p-value < 0.05. This indicates a significant effect of Pedagogical Competence (X1) on Achievement Motivation (Y). The resulting coefficient value is positive at 0.297. Therefore, higher Pedagogical Competence (X1) tends to increase Achievement Motivation (Y).

2) **The Effect of Pedagogical Competence (X1) on Learning Quality (Z)**
The test of the effect of Pedagogical Competence (X1) on Learning Quality (Z) yielded a T-statistic of 2.957 with a p-value of 0.003. The test results showed a T-statistic value > 1.96 and a p-value < 0.05. This indicates a significant effect of Pedagogical Competence (X1) on Learning Quality (Z). The resulting coefficient value is positive, at 0.207. Therefore, higher Pedagogical Competence (X1) tends to improve Learning Quality (Z).

3) **The Effect of Project-Based Learning (PjBL) Effectiveness (X2) on Achievement Motivation (Y)**
The test of the effect of Project-Based Learning (PjBL) Effectiveness (X2) on Achievement Motivation (Y) yielded a T-statistic value of 3.310 with a p-value of 0.001. The test results indicate a T-statistic value > 1.96 and a p-value < 0.05. This indicates a significant effect of Project-Based Learning (PjBL) Effectiveness (X2) on Achievement Motivation (Y). The resulting coefficient value is positive, at 0.280. Thus, it can be interpreted that the better the effectiveness of Project Based Learning (PjBL) (X2), the more it tends to increase Achievement Motivation (Y).

4) The Effect of Project-Based Learning (PjBL) Effectiveness (X2) on Learning Quality (Z)

The test of the effect of Project-Based Learning (PjBL) Effectiveness (X2) on Learning Quality (Z) yielded a T-statistic of 2.174 with a p-value of 0.030. The test results indicated that the T-statistic > 1.96 and the p-value < 0.05. This indicates a significant effect of Project-Based Learning (PjBL) Effectiveness (X2) on Learning Quality (Z). The resulting coefficient value is positive, at 0.222. Therefore, the better the Project-Based Learning (PjBL) Effectiveness (X2), the higher the Learning Quality (Z).

5) The Effect of Creativity (X3) on Achievement Motivation (Y)

The test of the effect of Creativity (X3) on Achievement Motivation (Y) yielded a T-statistic of 3.818 with a p-value of 0.000. The test results showed a T-statistic value > 1.96 and a p-value < 0.05. This indicates a significant effect of Creativity (X3) on Achievement Motivation (Y). The resulting coefficient value was positive, at 0.302. Therefore, it can be interpreted that better Creativity (X3) tends to increase Achievement Motivation (Y).

6) The Influence of Personality (X3) on Learning Quality (Z)

The test of the influence of Creativity (X3) on Learning Quality (Z) yielded a T-statistic value of 2.986 with a p-value of 0.003. The test results indicated a T-statistic value > 1.96 and a p-value < 0.05. This indicates a significant effect of Creativity (X3) on Learning Quality (Z). The resulting coefficient value was positive, at 0.213. Therefore, it can be interpreted that better Creativity (X3) tends to increase Learning Quality (Z).

7) The Effect of Achievement Motivation (Y) on Learning Quality (Z)

The test of the effect of Achievement Motivation (Y) on Learning Quality (Z) yielded a T-statistic of 2.986 with a p-value of 0.003. The test results indicate that the T-statistic is > 1.96 and the p-value is < 0.05. This indicates a significant effect of Achievement Motivation (Y) on Learning Quality (Z). The resulting coefficient is positive at 0.268. Therefore, higher Achievement Motivation (Y) tends to improve Learning Quality (Z).

Table 7. Indirect Effect Hypothesis Testing

No	Indirect Variable	Coefisien	T Statistics (|O/STDEV|)	P Values
8.	Pedagogical Competence (X1) → Achievement Motivation (Y) → Learning Quality (Z)	0.080	2.250	0.025
9.	Project-Based Learning (PjBL) Effectiveness (X2) → Achievement Motivation (Y) → Learning Quality (Z)	0.075	2.203	0.028
10.	Creativity (X3) → Achievement Motivation (Y) → Learning Quality (Z)	0.081	2.442	0.015

8) The Effect of Pedagogical Competence (X1) on Learning Quality (Z) Through Achievement Motivation (Y)

The test of the effect of Pedagogical Competence (X1) on Learning Quality (Z) through Achievement Motivation (Y) yielded a T-statistic of 2.250 with a p-value of 0.025. The test results indicate that the T-statistic is > 1.96 and the p-value is < 0.05. This indicates a significant effect of Pedagogical Competence (X1) on Learning Quality (Z) through Achievement Motivation (Y). Therefore, it can be concluded that Achievement Motivation (Y) can mediate the effect of Pedagogical Competence (X1) on Learning Quality (Z).

9) **The Effect of Project-Based Learning (PjBL) Effectiveness (X2) on Learning Quality (Z) Through Achievement Motivation (Y)**
The test of the effect of Project-Based Learning (PjBL) Effectiveness (X2) on Learning Quality (Z) through Achievement Motivation (Y) yielded a T-statistic of 2.203 with a p-value of 0.028. The test results indicate that the T-statistic is > 1.96 and the p-value is < 0.05. This indicates that there is a significant effect of Project-Based Learning (PjBL) Effectiveness (X2) on Learning Quality (Z) through Achievement Motivation (Y). Therefore, it can be concluded that Achievement Motivation (Y) can mediate the effect of Project-Based Learning (PjBL) Effectiveness (X2) on Learning Quality (Z).

10) **The Effect of Creativity (X3) on Learning Quality (Z) Through Achievement Motivation (Y)**
The test of the effect of Creativity (X3) on Learning Quality (Z) through Achievement Motivation (Y) yielded a T-statistic of 2.442 with a p-value of 0.015. The test results indicate that the T-statistic is > 1.96 and the p-value is < 0.05. This indicates a significant effect of Creativity (X3) on Learning Quality (Z) through Achievement Motivation (Y). Therefore, it can be concluded that Achievement Motivation (Y) can mediate the effect of Creativity (X3) on Learning Quality (Z).

3.7 Optimal Solutions for Improving Learning Quality

Based on the results of statistical hypothesis testing, indicator prioritization, and indicator value calculations as described above, a summary of the research results can be compiled, representing optimal solutions for improving learning quality, as follows:

Table 8. SITOREM Analysis

Pedagogical Competence (βz1 = 0,207) (rangk.IV)				
	Indicator in Initial State		**Indicator after Weighting by Expert**	**Indicator Value**
1	Mastering student characteristics	1st	Mastering student characteristics (21.17)	3.88
2	Ability to manage learning	2nd	Implementing learning outcome evaluations (21.13)	4.10
3	Utilization of learning technology	3rd	Utilizing learning technology (20.16)	4.00
4	Implementing evaluation of learning outcomes	4th	Learning management skills (20.17)	3.61
5	Developing students to actualize their various potentials	5th	Developing students to actualize their various potentials (17.37)	3.60
Effectiveness of Project Based Learning (PjBL) (βz2 = 0,222) (rangk.II)				
	Indicator in Initial State		**Indicator after Weighting by Expert**	**Indicator Value**
1	Presenting a complex problem	1st	Designing a method for creating a product/project (16.18)	3.57
2	Designing a method for creating the product/project	2nd	Developing a product/project creation schedule (16.13)	4.02

	Indicator in Initial State		Indicator after Weighting by Expert	Indicator Value
3	Developing a product/project creation schedule	3rd	Presenting the final product/project results (15.16)	3.68
4	Product/project investigation	4th	Monitoring the progress of the product/project (15.04)	4.04
5	Monitoring product/project progress	5th	Product/project investigation (13.16)	4.12
6	Presenting final product/project results	6th	Providing complex problems (13.12)	4.08
7	Documenting final product/project results	7th	Documenting the final product/project results (11.21)	3.74
Creativity (βz3 = 0,213) (rangk.III)				
	Indicator in Initial State		**Indicator after Weighting by Expert**	**Indicator Value**
1	Exploring curiosity	1st	Taking risks (20.38)	3.82
2	Generating new ideas	2nd	Combining ideas into something new (20.16)	3.84
3	Developing ideas persistently	3rd	Developing ideas persistently (20.13)	3.78
4	Combining ideas into something new	4th	Generating new ideas (20.12)	4.14
5	Taking risks	5th	Exploring curiosity (19.21)	4.02
Achievement Motivation (βy1 = 0,268) (rank.I)				
	Indicator in Initial State		**Indicator after Weighting by Expert**	**Indicator Value**
1	Self-drive to achieve goals	1st	Desire to excel in competition (26.37)	3.85
2	Desire to excel in competition	2nd	Self-drive to achieve goals (25.43)	4.11
3	Orientation toward high professional performance	3rd	Orientation toward high professional performance (24.56)	3.65
4	Strong desire for performance feedback	4th	Strong desire for performance feedback (23.64)	4.03
Quality of Learning				
	Indicator in Initial State		**Indicator after Weighting by Expert**	**Indicator Value**
1	Teacher Activities	1st	Classroom Climate (21.17)	3.78
2	Learning Facilities	2nd	Learning Facilities (21.13)	3.65
3	Classroom Climate	3rd	Student Attitudes (20.16)	4.15
4	Student Attitudes	4th	Student Learning Motivation (19.12)	3.86
5	Student Learning Motivation	5th	Teacher Activities (18.42)	4.16

SITOREM ANALYSIS RESULT		
Priority order of indicator to be Strengthened		**Indicator remain to be maintained**
1st	Desire to excel in competition	1. Self-drive in achieving goals
2nd	Orientation towards high professional performance	2. Strong desire to receive performance feedback
3rd	Designing ways to create products/projects	3. Developing a product/project development schedule
4th	Presentation of final product/project results	4. Monitoring product/project progress
5th	Documentation of final product/project	5. Investigating products/projects

	results	
6th	Taking risks	6. Presenting complex problems
7th	Combining ideas into something new	7. Generating new ideas
8th	Developing ideas persistently	8. Exploring curiosity
9th	Mastering student characteristics	9. Implementing learning outcome evaluations
10th	Ability to manage learning	10. Utilizing Learning Technology
11th	Developing students to actualize their various potentials	11. Student Attitudes
12th	Classroom Climate	12. Teacher Activities
13th	Learning Facilities	
14th	Student Learning Motivation	

4.0 CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Based on the analysis, discussion, and tested hypotheses, the following conclusions can be drawn:

1. Improving the quality of learning can be achieved by employing strategies to strengthen variables that positively influence learning quality.
2. The variables that positively influence learning quality are pedagogical competence, project-based learning (PjBL) effectiveness, creativity, and achievement motivation. This is evidenced by the results of variable analysis using the path analysis method using Smart PLS.
3. Improving the quality of learning involves improving weak indicators and maintaining strong indicators for each research variable.

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

1. To improve the quality of learning, it is necessary to strengthen pedagogical competence, the effectiveness of project-based learning (PjBL), and creativity, as exogenous variables, with achievement motivation as an intervening variable.
2. If pedagogical competence is to be developed, improvements must be made to the remaining weak indicators, namely: mastery of student characteristics, ability to manage learning, and student development to actualize their various potentials while maintaining or developing the indicators: implementation of learning outcome evaluation and utilization of learning technology.
3. To develop the effectiveness of Project-Based Learning (PjBL), it is necessary to improve the weak indicators: Designing a method for creating a product/project, Presenting the final product/project results, and Documenting the final product/project results. Furthermore, the following indicators should be maintained or developed: Developing a product/project creation schedule, Monitoring product/project progress, Investigating products/projects, and Providing complex problems.
4. To develop creativity, it is necessary to improve the weak indicators: Taking risks, Combining ideas into something new, and Developing ideas persistently. Furthermore, the following indicators should be maintained or developed: Generating new ideas, and Exploring curiosity.
5. To increase achievement motivation, it is necessary to improve the weak indicators: Desire to excel in competition, and Orientation towards high professional performance. Furthermore, the following indicators should be maintained or developed: Self-drive in achieving goals, and Strong desire to receive performance feedback.

Suggestions or recommendations that can be provided to relevant parties are as follows:

1. School principals need to improve the quality of learning by strengthening pedagogical competence, the effectiveness of project-based learning (PjBL), creativity, and achievement motivation. This includes improving classroom 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 administrators need to develop teachers to improve the quality of learning by providing appropriate guidance to strengthen pedagogical competence, the effectiveness of project-based learning (PjBL), creativity, and achievement motivation, in accordance with the findings of this study.

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