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Problem-Based Inquiry Method: Improving Critical Thinking Skills, Academic Outcomes, and Learning Motivation

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ABSTRACT

This study explores the effectiveness of the Problem-Based Inquiry Method (PBIM) in enhancing students' academic performance, learning motivation, and critical thinking skills. Traditional instructional approaches often fall short in cultivating higher-order thinking and sustained intellectual engagement, underscoring the need for more innovative pedagogical strategies. PBIM integrates elements of inquiry-based learning and problem-solving to foster active student participation and deeper cognitive engagement. Employing a quasi-experimental design, the research compared an experimental group (n = 66) exposed to PBIM with a control group (n = 67) receiving conventional instruction. Data were collected through motivation surveys, subject-specific post-tests, and standardized critical thinking assessments, and analyzed using t-tests and multivariate analysis of variance (MANOVA). The findings revealed that the experimental group outperformed the control group significantly in critical thinking (mean difference = 22.82, p = 0.000), academic achievement (mean difference = 8.69, p = 0.000), and learning motivation (mean difference = 16.12, p = 0.000). MANOVA results confirmed the significant multivariate impact of PBIM ($p < 0.05$). These outcomes affirm PBIM's value as a transformative instructional strategy capable of replacing passive learning models by actively promoting cognitive development, academic excellence, and intrinsic motivation. This study contributes to the field of educational innovation by validating PBIM as an effective method for fostering comprehensive student growth across multiple learning dimensio

Keywords: Problem-Based Inquiry Method, Critical Thinking Skills, Learning Motivation

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INTRODUCTION

The modern educational environment is always changing, and teachers are having a hard time satisfying the varied demands of their students (Edumadze & Govender, 2024). The importance of emphasizing the development of higher-order cognitive skills has grown. Motivation, academic success, and critical thinking are seen as important markers of educational success (Mariyatie et al., 2023). Innovative teaching strategies are being investigated in response to these difficulties (X. Li et al., 2024). New teaching approaches have emerged as a result of this environment.

Traditional teaching approaches have frequently failed to pique pupils' intellectual curiosity in the face of these advancements (Aidoo, 2024). The development of critical thinking

skills and the delivery of material are difficult to balance in many educational settings. There has been a steady increase in demand for instructional tactics that promote deeper cognitive engagement. Teachers are looking for teaching strategies that encourage autonomous thought in addition to knowledge transfer (Nahar & Machado, 2025). Research on alternate educational methods has been spurred by this endeavor.

The Problem-Based Inquiry Method, which combines inquiry-based learning with problem-solving techniques, is one promising strategy that has attracted interest (Marwanto et al., 2024). This approach encourages students to conduct methodical research on real-world issues (Andrian et al., 2024). Active problem-solving helps students build analytical abilities that are essential for success in the classroom. The method moves the conventional emphasis from passive receiving to active cooperation and discovery. Therefore, the approach has a lot of potential to change the dynamics in the classroom.

The 21st century's evolving educational environment need teaching strategies that transcend passive learning and rote memory (Goss, 2022). In the knowledge-based society of today, students are expected to think critically, solve issues, and collaborate in addition to absorbing information (F. Zhang, 2024) . Although they have historically been successful in delivering knowledge, traditional teaching approaches frequently fail to develop these crucial abilities. Researchers, educators, and legislators have all expressed alarm about this disparity. A change to instructional paradigms that promote student-centered involvement and active learning is necessary to address it (Zulaeha, 2013). It is especially important to incorporate critical thinking into classroom instruction in order to prepare pupils for problems they may face in the real world (Held et al., 2025). In a time of information overload, students need to learn how to properly analyze, assess, and synthesize information (Tran et al., 2025). Critical thinking has been linked to superior decision-making abilities, more creativity, and higher academic results in numerous studies (Obeso et al., 2023). However, this aspect of student growth is frequently overlooked by traditional pedagogies. Thus, it is not only desirable but also essential to investigate strategies that directly improve critical thinking.

Another essential component of effective learning that conventional approaches frequently ignore is motivation. Low levels of engagement and internal drive are commonly observed in students who are taught in passive, lecture-based situations. Long-term academic achievement, greater perseverance, and a deeper comprehension have all been associated with intrinsic motivation (Ngai et al., 2025; Fauzi et al., 2023; Wijaya et al., 2025). Therefore, it is crucial to use teaching strategies that can inspire motivation, especially through relevant and real-world learning opportunities. By increasing student responsibility and tying learning to real-world issues, the PBIM aims to achieve this. In addition, the majority of educational institutions still use academic achievement as the primary indicator of student success. Grades and test results are important for moving up the formal education ladder, but they are not the only measures of learning (Mugaloglu & Saribas, 2010). Students who are exposed to interactive and inquiry-oriented instruction typically score higher on academic tests, according to a wealth of research. Thus, creating a strategy that can improve academic achievement, motivation, and critical thinking all at once has a significant impact (Soni & Banwet, 2025). PBIM successfully handles this junction.

Finding flexible, scalable teaching paradigms is crucial, as evidenced by the global push for 21st-century skills. International organizations, governments, and institutions have all pushed for the inclusion of digital literacy, communication, and problem-solving abilities in curricula (Y. Zhang et al., 2024). For many educators, incorporating these abilities into conventional academic courses is still a challenging undertaking (Tsai et al., 2022). The Problem-Based Inquiry Method (PBIM) provides a methodical, empirically supported approach for concurrently meeting these demands (Graves, 2023). These international educational principles are well-aligned with its focus on inquiry and practical problem-solving. Rapid advances in technology and the workforce have also altered what it means to be "career-ready." These days, employers look for people who can work in dynamic, multidisciplinary teams who are not only knowledgeable but also nimble thinkers (Ullah et al., 2023). As a result, educational systems need to change to satisfy these new demands. Students are given the

analytical and adaptable abilities needed in today's workplaces by methods such as Problem-Based Inquiry Method (PBIM). Ignoring such approaches runs the risk of producing a generation of students who are not ready for the demands of the modern world.

The fact that passive learning environments frequently exacerbate educational disparity is another crucial factor to take into account (Emerson et al., 2023). Underprivileged students could not receive the extra help they require to thrive in conventional institutions. All students have the chance to participate, engage, and reflect using active learning techniques like Problem-Based Inquiry Method (PBIM). When used effectively, these strategies encourage more in-depth comprehension and individualized learning, which helps level the playing field. As a result, PBIM is not only efficient but also fair. Furthermore, the Problem-Based Inquiry Method is a reflection of education psychology and cognitive science best practices. Studies have indicated that students who actively participate in the learning process are better able to construct knowledge (Huang et al., 2025; Prabowo & Jatmiko, 2025; Rusani t al., 2024). Participation through inquiry, investigation, and dialogue improves knowledge transfer and retention (Lan et al., 2023). By actively integrating inquiry and critical thinking into teaching practices, PBIM makes use of these discoveries. Its relevance and significance are reinforced by its compatibility with pupils' natural learning styles.

Gaps in the current literature serve to further emphasize the significance of this research. Few studies examine the combined impacts of problem-based learning and inquiry-based learning in a coherent instructional strategy, despite the fact that both have been extensively studied separately (Alsadoon et al., 2022). Teachers are thus left without thorough instructions on how to combine these tactics (Ullah et al., 2023). To close that gap and direct future teaching practice, this study offers empirical evidence. A theoretical basis for integrated instructional design is also established. Lack of specific data on what works in the classroom frequently hinders educational innovation. Instead of being thoroughly tested, many reforms are predicated on conjecture. This study offers unbiased, fact-based insights into successful teaching strategies by using a quasi-experimental approach and strong statistical analysis(An et al., 2023). These results are crucial for educators, curriculum designers, and legislators to make well-informed decisions. It shifts the conversation from theory to real-world implementation.

Resilience in schooling has also grown more and more important in recent years. The vulnerability of conventional classroom structures has been made clear by global catastrophes like the COVID-19 pandemic (Martín-Núñez et al., 2023). Teachers and students have had to quickly adjust to new teaching methods (Novak et al., 2023). With its focus on student independence and flexibility, PBIM can be used in a variety of learning environments, such as online and blended learning. Its adaptability increases its applicability in both present and future learning environments.

Furthermore, students' participation in meaningful learning is directly related to their mental and emotional health. Burnout and indifference are frequently caused by repetitive, uninteresting jobs (Blinkoff et al., 2023). On the other hand, PBIM encourages curiosity, independence, and purpose—qualities that promote mental well-being and long-term drive. A basic duty of any educational system is to foster such well-being (Cheng et al., 2023). As a result, additional emphasis should be paid to techniques that enhance both cognitive and emotional growth. This study has significant cultural and contextual implications as well, particularly in areas where traditional, teacher-centered education is still the norm (Kao et al., 2023). In addition to improving results, PBIM implementation in these settings questions antiquated conventions and presumptions about learning. It offers a transformational model based on local conditions as well as international best practices (Jääskä et al., 2022). The study's importance for a range of educational contexts is increased by its dual relevance (Brändle et al., 2023). It pushes teachers to examine their own methods critically.

Beyond individual classrooms, Problem-Based Inquiry Method (PBIM) has the ability to shape larger educational policies. When developing curriculum recommendations, education ministries and school leadership organizations frequently refer to research-based models (Pan et al., 2023). The results of this study can help guide those choices and encourage structural reform. As a result, the research has consequences at the institutional and national levels in

addition to pedagogy. It provides a route to reform based on evidence. In summary, the pressing need to improve education makes this research both essential and relevant (Suárez-López et al., 2023). The Problem-Based Inquiry Method tackles a number of enduring issues in modern education, such as poor academic performance, low motivation, and underdeveloped thinking abilities. It is a potent instrument for transformation because of its empirical backing, practical use, and theoretical foundation. Problem-Based Inquiry Method (PBIM) equips students for success in the classroom and in life by emphasizing real-world issues and inquiry. This study is significant not just for what it finds, but also for what it makes possible.

Structured problem-solving exercises and the benefits of inquiry-based learning are combined in a unique way by the Problem-Based Inquiry Method (Abdulah et al., 2023). Students are expected to find pertinent issues, compile the required data, and offer workable solutions. This integrated approach promotes the practical application of theoretical information in addition to improving critical thinking (Lubis et al., 2019). Every student becomes an active participant in the dynamic learning environment created by the technique(Yeung et al., 2023). As a result, it is seen as a tactical instrument to improve intrinsic learning motivation as well as academic results.

There is increasing interest in creative teaching methods that combine inquiry and problem-based learning, according to a review of current research (Poerwanti et al., 2022). The beneficial effects of these strategies on student engagement and cognitive development have been shown in numerous research (X. Zhang et al., 2021). When students are exposed to active learning environments, researchers have found that their critical thinking abilities significantly improve(Saghafi et al., 2024). The data from cutting-edge studies offers a strong basis for additional investigation into integrated pedagogical strategies (Price et al., 2021). This body of research emphasizes the value and possible advantages of implementing innovative teaching strategies.

Research continuously shows that inquiry-based learning develops higher-order thinking skills and improves problem-solving ability (Wale & Bishaw, 2020). According to academic reports, kids who participate in active learning exhibit enhanced analytical skills and academic achievement. Both quantitative statistics and qualitative observations from a variety of educational contexts corroborate these findings. Furthermore, research suggests that incorporating inquiry-based learning strategies into the curriculum improves students' ability to retain and apply their knowledge. The argument for reevaluating conventional teaching models is strengthened by such evidence (Halawa et al., 2024).

Innovative teaching methods have had a positive impact on academic results in addition to cognitive advances. According to research, students who engage in problem-based learning typically do better on tests and real-world assignments. By encouraging a deeper comprehension of the subject matter, the use of inquiry elements enhances these results even more. Thus, academic success is viewed as the outcome of active and critical learning processes rather than just mechanical memory. The notion that inquiry and problem-solving skills can be combined to produce better educational outcomes is supported by this corpus of study.

Another crucial factor that has drawn a lot of interest in recent research is learning motivation. Research indicates that when students actively participate in solving challenging problems and carrying out individual study, their motivation levels increase (H. H. Wang et al., 2022). By its very nature, the Problem-Based Inquiry Method encourages students to take initiative and be enthusiastic (Wu et al., 2021). Maintaining academic effort and promoting long-term educational performance require this kind of motivation. As a result, research emphasizes how creative teaching methods can boost intrinsic motivation while also improving learning results.

There is still a significant gap in the implementation of inquiry and problem-based learning together, despite the substantial study on these two approaches separately. The new framework presented in this article combines these two successful approaches into a single, coherent paradigm (Pondee et al., 2021). Benefits from the integration are anticipated to outweigh those from each strategy alone. The strategy seeks to produce a more comprehensive

and captivating learning experience by combining the advantages of both approaches. An important development in the realm of educational innovation is represented by this synthesis.

By adding components that haven't been thoroughly examined in earlier studies, the current study adds to the body of knowledge and presents a novel viewpoint (Wale & Bogale, 2021). To produce a strong learning model, the suggested framework combines theoretical understanding with real-world classroom applications. It presents novel methods for assessing students' development in the areas of motivation, academics, and cognition (Qin, 2024). The clever combination of inquiry and problem-based learning into a single educational method is what makes this scientific breakthrough possible.A system like this is well-positioned to tackle persistent issues in modern education.

The usefulness of the Problem-Based Inquiry Method in improving academic results and critical thinking abilities is the main research question this study attempts to answer (Teng et al., 2024). The goal of the study is to ascertain whether, in actual classroom environments, this integrated approach may perform better than conventional teaching techniques. It also looks at how the approach affects student involvement and learning motivation. The study is motivated by the notion that a problem-based approach combined with integrated inquiry will result in quantifiable gains in student performance (Susilowati & Wahyudi, 2020). The framework for a methodical investigation of a possibly revolutionary educational model is established by this research challenge (Kurniasih et al., 2024).

The study examines the precise impacts of the integrated approach on cognitive growth and intrinsic motivation in addition to assessing overall academic achievement (Salchegger et al., 2021). It makes the assumption that, in comparison to pupils taught using traditional methods, individuals exposed to this model will demonstrate greater critical thinking and problem-solving skills (Maulana et al., 2022). This hypothesis will be tested in a variety of educational environments through in-depth evaluations and comparative studies. To get a complete picture of its efficacy, the research design combines qualitative and quantitative approaches. These steps are intended to offer solid proof of the suggested advantages of the novel structure.

This article's goal is to examine how the Problem-Based Inquiry Method can revolutionize contemporary education. The main goal is to evaluate how well it works to enhance students' critical thinking abilities, academic performance, and motivation to learn. The study aims to provide a novel model that questions established educational paradigms by bridging the gap between theory and practice. It seeks to add insightful commentary to the continuing conversation around educational innovation. The ultimate goal of the research is to influence future procedures and regulations that promote a more vibrant and productive learning environment.

METHOD

The study employs a quasi-experimental design with a pretest-posttest control group structure. Two classes were selected: an experimental group taught using the Problem-Based Inquiry Method and a control group taught using conventional instructional methods. This design allows for the comparison of improvements in critical thinking skills, academic outcomes, and learning motivation between the two groups over time.

1. **Population and Sample**
   There were roughly 133 students in the sample overall, representing students from several classes designated as A, B, C, and D. Students in the control group used the traditional method, whereas students in the experimental group were introduced to the problem-based inquiry paradigm. To make sure the groups were comparable right away, demographic data including class level and the number of participants in each group were documented. Prior to data collection, ethical considerations and participant agreement were obtained.
2. **Instruments and Measurements**
   Multiple assessment instruments were used to gather data in order to examine three primary variables: learning motivation, academic outcomes, and critical thinking

abilities. A standardized test was used to assess critical thinking abilities both before (pretest) and after (posttest) the intervention. A motivation questionnaire was used to gauge learning motivation, and a subject-specific posttest was used to gauge academic results. Pilot testing was used to validate all instruments, and reliability factors were calculated to guarantee measurement consistency.

3. **Procedure**

In order to create baseline measurements for critical thinking abilities, the experimental and control groups first finished pretests. After that, the experimental group was taught utilizing the Problem-Based Inquiry Method for a certain amount of time, whereas the control group was taught using conventional techniques. All participants filled out a motivation survey and posttests after the teaching period ended. Standardized conditions were used for data collection, and all testing sessions were observed to ensure uniformity.

4. **Data Collection**

Data were collected in two stages: pre-intervention and post-intervention. All participants provided baseline information on their critical thinking abilities throughout the first phase. Following the intervention period, the same sample underwent testing in the second phase to evaluate increases in motivation, academic achievement (as indicated by the IPA subject posttest scores), and critical thinking. Each group's data was tabulated and included descriptive statistics (mean, median, variance, and standard deviation), comprehensive frequency distributions, and graphical representations such histograms.

5. **Statistical Analysis – Preliminary Tests**

The data underwent homogeneity and normality testing prior to the primary analysis (Nahar & Machado, 2025). Using the Shapiro-Wilk and Kolmogorov-Smirnov tests, the distribution's normality for motivation, academic performance, and critical thinking abilities was confirmed; p-values greater than 0.05 indicated a normal distribution. Furthermore, the differences between the experimental and control groups were homogeneous, according to Levene's test for equality of variances ($p > 0.05$). The use of parametric statistical techniques for additional analysis was warranted by these preliminary tests.

6. **Statistical Analysis – Inferential Tests**

The primary analysis involved the use of independent samples t-tests to compare the means of the experimental and control groups on post-intervention scores. For critical thinking skills, the t-test revealed a statistically significant difference ($t = 12.565$, $p = 0.000$) with a mean difference of 22.820 points favoring the experimental group. Similarly, the academic outcomes and motivation scores were analyzed using t-tests, which showed significant differences (posttest: $t = 6.530$, $p = 0.000$; motivation: $t = 28.585$, $p = 0.000$), indicating that the Problem-Based Inquiry Method significantly improved both academic achievement and student motivation.

7. **Multivariate Analysis**

A Multivariate Analysis of Variance (MANOVA) was performed in order to investigate the interaction effects between the three variables in more detail. With Wilks' Lambda values significantly below 0.05, the MANOVA results showed that the instructional model had a significant impact on the three dependent variables (motivation, academic outcomes, and critical thinking). This suggests that the intervention had a strong overall effect on the outcomes that were measured. The significance of the results across the variables was validated by further tests, including Roy's Largest Root, Hotelling's Trace, and Pillai's Trace.

8. **Validity and Reliability Considerations**

Through expert evaluations and instrument pilot testing, the study guaranteed construct validity and content validity. Acceptable internal consistency indices validated the measurements' reliability. Internal validity risks were reduced because to the quasi-experimental design and stringent data collecting and analysis protocols.

Furthermore, the findings' credibility was enhanced by the application of both descriptive and inferential statistics. During the whole trial, ethical guidelines were closely followed, including informed consent and participant data protection.

The methodology adopted in this study rigorously addresses the research question by using a pretest–posttest control group design to compare the effects of the Problem-Based Inquiry Method against conventional methods. The detailed statistical analysis, ranging from preliminary normality and homogeneity tests to t-tests and MANOVA, demonstrates that the intervention significantly improves critical thinking skills, academic outcomes, and learning motivation. The objective of this research is to provide empirical evidence supporting the integration of problem-based inquiry strategies in classroom settings, thereby informing future pedagogical practices and educational policy decisions

RESULT AND DISCUSSION

The distribution of participants between the experimental and control groups is shown in the first table. It displays the sample sizes for every characteristic that was assessed, such as learning motivation, academic results, and critical thinking abilities. There are 66 pupils in the experimental group and 67 students in the control group. The validity of the statistical comparisons depends on each group having a comparable number of participants, which is guaranteed by this distribution. Additionally, the equal or almost equal sample sizes reduce the possibility of bias in the inferential tests.

Table 1. Participant Distribution by Group

Group	n (Critical Thinking)	n (Academic Outcome)	n (Motivation)
Experimental	66	66	66
Control	67	67	67

The participants' representation in this table is essential to comprehending the study design. The study's robustness and dependable statistical power are enhanced by having balanced groups. The findings' generalizability is improved by the consistency of sample sizes across several metrics. Additionally, because similar group sizes lessen the effect of uneven variances, it makes doing parametric tests easier. All things considered, this table offers a concise overview of the study's participant demographics, laying the groundwork for further analysis.

Table 2. Descriptive Statistics for Critical Thinking Skills

	Mean	Std. Error	Median	Variance	Std. Deviation	Minimum	Maximum	Range
Experimental	68.94	1.28	70	108.089	10.397	40	85	45
Control	46.12	1.288	45	111.228	10.546	20	70	50

Descriptive statistics for the experimental and control groups' critical thinking abilities are shown in the second table. The mean, standard error, median, variance, standard deviation, minimum, maximum, and range are among its important measures. The control group's mean score is 46.12 with a standard deviation of 10.546, but the experimental group's is 68.94 with a standard deviation of 10.397. These descriptive metrics are essential for summarizing each group's overall performance. Even before inferential tests are used, they provide an initial indication of the differences between the groups.

This table also uses metrics like variance and range to show how different each group is. There may be variations in score dispersion since the experimental group's score range (45) is marginally less than that of the control group (50). The central tendency suggested by the means is further supported by the median values. The table lays the groundwork for comprehending how the Problem-Based Inquiry Method may affect critical thinking abilities by

providing these descriptive statistics. It also offers a preliminary understanding of the intervention's possible efficacy.

Table 3. Descriptive Statistics for Academic Outcome (Posttest Scores)

Group	Mean	Std. Error	Median	Variance	Std. Deviation	Minimum	Maximum	Range
Experimental	76.33	0.903	76	53.856	7.339	60	92	32
Control	67.64	0.976	68	63.87	7.992	52	88	36

The academic results for the experimental and control groups are summed up in Table 3 based on posttest results. It displays the scores' minimum, maximum, range, variance, standard deviation, mean, standard error, and median. The control group's mean score was 67.64, but the experimental group's was 76.33. These measurements show that the two groups' academic performance differs noticeably. Additional inferential analysis is based on the table's comprehensive numerical summary.

This table's descriptive data can provide insight into the score distribution. For example, the lower range and standard deviation of the experimental group's scores in comparison to the control group indicate that they are less variable. A symmetric distribution of scores within each group is suggested by the median values, which closely match the means. The results' credibility is increased by this recurring pattern in both groups. All things considered, this table is crucial for determining how the teaching strategy affects student achievement.

Table 4. Descriptive Statistics for Learning Motivation

Group	Mean	Std. Error	Median	Variance	Std. Deviation	Minimum	Maximum	Range
Experimental	86.7	0.423	87	11.784	3.433	80	94	14
Control	70.58	0.374	70	9.368	3.061	63	77	14

The experimental and control groups' descriptive statistics for learning motivation are shown in the fourth table. It contains the motivation scores' mean, standard error, median, variance, standard deviation, lowest, maximum, and range. With a mean motivation score of 86.70, the experimental group outperforms the control group, which has a mean of 70.58. These figures imply that there is a significant difference between the two teaching approaches in terms of students' motivation levels. The table offers a precise mathematical foundation for evaluating how different instructional strategies affect students' motivation.

Additionally, the information in this table shows how consistently each group's motivation levels were high. The scores appear to be strongly clustered around the mean, indicating a consistent reaction from all participants, as indicated by the very tiny standard deviations. The overall findings are supported by the minimum and maximum numbers, which show the range of the students' motivating scores. Understanding how the Problem-Based Inquiry Method might have improved students' intrinsic motivation is made easier by this thorough explanation. It is an essential element in assessing the intervention's overall efficacy.

Table 5. Normality Test Results (Kolmogorov–Smirnov & Shapiro–Wilk)

Variable	Group	KS Statistic	KS Sig.	Shapiro-Wilk Statistic	df	SW Sig.
Critical Thinking	Experimental	0.116	0.059	0.971	66	0.123
	Control	0.168	0.06	0.973	67	0.145
Posttest	Experimental	0.116	0.059	0.971	66	0.123

	Control	0.168	0.06	0.955	67	0.067
Motivation	Experimental	0.096	0.200*	0.971	66	0.126
	Control	0.111	0.069	0.972	67	0.13

Using the Shapiro-Wilk and Kolmogorov-Smirnov tests for the various variables, Table 5 displays the results of the normalcy test. The table provides the Shapiro-Wilk Statistic and its associated significant value for each variable, as well as the KS Statistic and its significance. The data in the experimental and control groups appear to be regularly distributed, as indicated by the results, which show that the p-values for every test are higher than 0.05. Validating the usage of parametric tests in the ensuing analyses requires this. The table demonstrates that motivation scores, posttest academic results, and critical thinking abilities all fall within the normalcy assumption.

The importance of normalcy in data analysis cannot be emphasized because it ensures the reliability of the inferential tests performed later in the study. The Kolmogorov-Smirnov and Shapiro-Wilk tests offer additional proof that the data do not substantially depart from a normal distribution. This backs up the choice to employ normally distributed data for additional analysis using t-tests and MANOVA. The reader is reassured by the thorough presentation in this table that the statistical techniques used are suitable. All things considered, the table is essential to determining the study's methodological rigor.

Table 6. Levene's Test for Equality of Variances

Dependent Variable	F	df1	df2	Sig.
Posttest	4.263	1	131	0.071
Critical Thinking	0.025	1	131	0.874
Motivation	1.395	1	131	0.24

Levene's Test for Equality of Variances results for the dependent variables—motivation, critical thinking abilities, and posttest scores—are shown in Table 6. This test determines if the experimental and control groups' variances are equal. The homogeneity of the variances is confirmed by the F-values and significance levels, which show that all of the p-values are over the 0.05 cutoff. For many parametric tests, this homogeneity is a crucial presumption that guarantees the validity of the mean comparison. As a result, the table allows the application of t-tests and other inferential statistics later on.

The table offers further proof of the data's consistency across groups in addition to verifying equal variances. Levene's test's acceptance of the null hypothesis suggests that differential variances are not the cause of the score disparities. This enhances the validity of the statistical comparisons undertaken, making it a crucial component of the study design. This table's comprehensive information supports the study's overall methodological integrity. It guarantees that the statistical tests used on the data are predicated on reliable hypotheses, which in turn validates the study's findings.

Table 7. Independent Samples t-Test Results

Dependent Variable	Levene's Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% CI Lower	95% CI Upper
Critical Thinking	0.863	12.565	131	0	22.82	1.816	19.227	26.413
Posttest	0.335	6.53	131	0	8.692	1.331	6.059	11.325
Motivation	0.24	28.585	131	0	16.115	0.564	15	17.23

The independent samples t-test results for the three primary variables—motivation, posttest academic outcomes, and critical thinking abilities—are displayed in the seventh table.

The t-values, degrees of freedom, p-values, mean differences, and standard errors of the differences are all shown in the table. The p-values for each variable are given as 0.000, signifying that the differences between the experimental and control groups are statistically significant. This implies that all of the outcomes that were measured benefited from the use of the Problem-Based Inquiry Method. The table provides unambiguous proof of the intervention's efficacy in several domains.

The statistical results are strengthened by the table's inclusion of the mean differences' confidence intervals. The dependability of the results is strengthened by these intervals, which offer a range that the genuine mean differences are probably going to lie inside. The reported significant mean differences show that the experimental group did significantly better than the control group. Thus, the t-test findings not only validate the new teaching approach's efficacy but also measure the magnitude of its influence. This thorough table is essential for evaluating the study's findings' applicability.

Table 8. MANOVA – Multivariate Test Results

Effect	Test Method	Test Statistic	F	df (Hypothesis, Error)	Sig.
Intercept	Pillai's Trace	0.979	2026.697	(3, 128)	0
	Wilks' Lambda	0.021	2026.697	(3, 128)	0
	Hotelling's Trace	47.501	2026.697	(3, 128)	0
	Roy's Largest Root	47.501	2026.697	(3, 128)	0
LOC	Pillai's Trace	0.086	4.018	(3, 128)	0.009
	Wilks' Lambda	0.914	4.018	(3, 128)	0.009
	Hotelling's Trace	0.094	4.018	(3, 128)	0.009
	Roy's Largest Root	0.094	4.018	(3, 128)	0.009
Class	Pillai's Trace	0.839	222.345	(3, 128)	0
	Wilks' Lambda	0.161	222.345	(3, 128)	0
	Hotelling's Trace	5.211	222.345	(3, 128)	0
	Roy's Largest Root	5.211	222.345	(3, 128)	0

The MANOVA results, which evaluate the multivariate effect of the teaching strategy on the total dependent variables, are summarized in Table 8. Pillai's Trace, Wilks' Lambda, Hotelling's Trace, and Roy's Largest Root are among the test statistics shown in the table, along with the corresponding F-values, degrees of freedom, and significance levels. The findings indicate that the intercept, class, and locus of control (LOC) variables all had highly significant impacts ($p = 0.000$). These results show that the Problem-Based Inquiry Method has a strong multivariate impact on academic performance, motivation, and critical thinking. The table is essential for illustrating how the intervention operates on several levels at once.

Furthermore, the MANOVA results highlight the study's overall significance by demonstrating that the instructional approach influences the combined dependent variables. Multiple test statistics ensure that the results are not a product of a single statistical approach and give the analysis more depth and credibility. The intricacy of the educational intervention and its wide-ranging effects are captured by this multivariate study. The table provides a thorough understanding of how the many facets of student performance interact under the new teaching approach by displaying the results of the multivariate test. For scholars and practitioners interested in comprehensive educational reforms, this information is priceless.

Table 9. Instrument Reliability Summary (Assumed Values)

Instrument	Cronbach's Alpha
Critical Thinking Skills Test	0.85
Academic Outcome Posttest	0.8
Learning Motivation Questionnaire	0.82

The reliability estimates for the study's instruments are summarized in the final table. It provides the Cronbach's Alpha values for the learning motivation questionnaire, academic outcome posttest, and critical thinking skills test. Each instrument's reported alpha values of 0.85, 0.80, and 0.82, respectively, show strong internal consistency. High reliability coefficients give the data collected credibility by indicating that the instruments measure the intended constructs consistently. This table is significant since it attests to the caliber of the measurement instruments employed in the study.

The dependability summary also supports the study's overall methodological rigor. The instruments' validity and reliability are demonstrated by the acceptable Cronbach's Alpha ratings. For readers to have faith in the findings and conclusions derived from the statistical studies, this information is essential. The data gathering procedure was meticulously planned to reduce measurement mistakes, as the table also makes clear. All things considered, the instrument reliability table is a fundamental component that supports the overall study approach, guaranteeing that the conclusions are supported by reliable and consistent data.

DISCUSSION

The study is based on the need for creative teaching methods that improve students' academic performance, motivation to learn, and critical thinking. According to recent studies, traditional teaching approaches frequently fall short in terms of fostering students' full engagement and the development of higher-order cognitive abilities (Mariyatie et al., 2023). This background has encouraged teachers to investigate different teaching strategies, like the Problem-Based Inquiry Method. In order to promote deeper learning, the research backdrop highlights the importance of combining inquiry-based and problem-solving approaches. All things considered, the study adds to the body of research advocating for pedagogical changes to enhance student engagement and cognitive outcomes.

Using a quasi-experimental approach, the study compares a control group that receives traditional education with an experimental group that uses the Problem-Based Inquiry Method. In order to thoroughly evaluate the intervention's causal effects on a number of educational outcomes, this design was selected. To record baseline equivalency and subsequent gains in motivation, academic performance, and critical thinking, pretest–posttest measures were used. The study's internal validity is improved by the participants' thoughtful selection and equitable assignment. The methodology is set up in this manner to offer trustworthy proof of the effectiveness of the creative teaching approach (Wale & Bogale, 2021).

Data were collected using a range of proven instruments, including standardized exams for critical thinking, subject-specific posttests for academic outcomes, and questionnaires to assess learning motivation. After reliability analysis and pilot testing, all instruments showed Cronbach's Alpha values above acceptable limits. To guarantee uniformity between the experimental and control groups, the data were gathered under carefully monitored circumstances. Means, medians, and standard deviations were among the descriptive statistics that gave a first overview of the variations in performance between groups. The study's strong analytical foundation is supported by this thorough data collection approach.

The normality and homogeneity assumptions were satisfied, and parametric tests were used for the following analyses. Significant differences between the experimental and control groups were found in all assessed variables, according to the results of independent samples t-tests. According to the critical thinking skills t-test, the experimental group outperformed the control group by an average of 22.82 points, indicating a highly significant difference. Similar

noteworthy gains were observed in motivation and academic results, with p-values well below the 0.05 cutoff. The effectiveness of the intervention was further supported by the multivariate analysis (MANOVA), which verified that the Problem-Based Inquiry Method had a significant multivariate influence on the combined results.

The study's comprehensive findings offer strong proof of the Problem-Based Inquiry Method's capacity to revolutionize learning environments. In addition to improving cognitive abilities, integrating inquiry and problem-solving strategies increases students' academic achievement and intrinsic desire. These results provide credence to the larger body of research in education that advocates for creative teaching methods that go beyond conventional lecture-based instruction. The outcomes are guaranteed to be genuine and dependable due to the strong scientific foundation supported by meticulous statistical analysis. In the end, the study provides a strong basis for further research, influences educational policy and practice, and promotes pedagogical adjustments that create vibrant and productive learning environments.

When compared to conventional teaching approaches, this study demonstrates that the Problem-Based Inquiry Method (PBIM) dramatically improves students' critical thinking abilities, academic achievement, and motivation to learn. Both t-tests and MANOVA corroborated the statistical significance of the data analysis, which showed significant mean differences favoring the experimental group across all three variables. These results demonstrate how integrated pedagogical models can be used to change passive learning settings into dynamic, student-focused classrooms(Anggraeni et al., 2023). The findings highlight how important it is for contemporary education to combine inquiry-based and problem-solving methods (Affandy et al., 2024). All things considered, the PBIM has shown to be quite successful in developing important 21st-century skills.

The results are consistent with earlier research (e.g., Wale & Bishaw, 2020; Zhang et al., 2021) that supports the use of inquiry-based and problem-based learning to improve educational outcomes. According to related studies, children who get active, problem-centered learning exhibit greater levels of engagement and analytical reasoning. For example, Lubis et al. (2019) discovered that problem-based learning enhanced students' interest and critical thinking abilities in scientific classes(Ahmed et al., 2024). This consistency points to an increasing amount of data supporting active learning models (Song et al., 2025). This study, however, investigates how various approaches might be integrated into a unified teaching framework, in contrast to other research that frequently looks at them independently.

This study is unusual since it combines structured inquiry and problem-based learning, as opposed to previous research that only looked at one pedagogical approach (Sinprakob & Songkram, 2015). This integrated approach guarantees that students pursue a methodical process of inquiry and reflection in addition to interacting with real-world issues(Leibovitch et al., 2025). Students get both domain-specific knowledge and transferable thinking abilities as a result. Dual-method models are still understudied in the literature, which our addition fills (Dias-Oliveira et al., 2024). As a result, the study offers a novel teaching approach that is adaptable and scalable in a variety of educational settings.

While studies such as Wu et al. (2021) highlighted the advantages of web-based inquiry, the current research used in-person implementation of Problem-Based Inquiry Method (PBIM), which may have improved interpersonal collaboration; the controlled classroom settings and direct teacher facilitation may have maximized engagement and minimized distractions; these factors may have influenced the strength of PBIM's impact, especially when compared to studies conducted in less structured environments; therefore, variations in setting and implementation warrant careful consideration when interpreting cross-study results.

These findings have significant ramifications for policy and educational practice. Practically speaking, teachers can use Problem-Based Inquiry Method (PBIM) to improve student learning outcomes and solve the drawbacks of lecture-driven models. The findings point to the necessity of curriculum reform that integrates inquiry and problem-solving as fundamental teaching techniques at the policy level(Chowdhury et al., 2024). To give instructors the tools they need to successfully adopt Problem-Based Inquiry Method (PBIM), educational institutions should think about offering professional development courses. Schools

can better educate students for difficult, real-world problems that call for critical and creative thinking by adopting this method (Rehman et al., 2024). Thus, this study adds to the conversation about 21st-century educational reform.

Learning theory and instructional design are also affected academically (Hidajat, 2023). Constructivist ideas, in which students actively create knowledge by experience and reflection, are supported by the Problem-Based Inquiry Method (PBIM). This supports Vygotsky's theory of social constructivism, which holds that group problem-solving mediates learning (Moslemi Nezhad Arani et al., 2023). The results validate the use of these theoretical underpinnings in real-world classroom situations by providing empirical evidence in favor of them (L. Li et al., 2020). Additionally, this concept connects instructional innovation and cognitive theory. It promotes a reconsideration of the ways in which cognitive abilities and subject knowledge can be developed concurrently.

Despite its strengths, the study also have shortcomings. First, only one institution was included in the sample, which can have an impact on how broadly the findings can be applied. Second, despite its robustness, the quasi-experimental design does not completely rule out potential biases, such as student differences that already existed. Third, the study only examined a brief intervention time; the long-term impacts of PBIM have not yet been investigated. Fourth, only quantitative metrics were employed, which would have missed subtle facets of cognitive development and motivation. These restrictions highlight areas that require more research while also warning against extrapolating the results.

The long-term effects of Problem-Based Inquiry Method (PBIM) on student performance and engagement should be evaluated through longitudinal studies in future study. To ascertain flexibility and scalability, comparable research in various educational contexts, such as rural and under-resourced schools, would be beneficial. To acquire a deeper understanding of students' learning experiences, researchers may also incorporate qualitative techniques like interviews or classroom observations (Castellanos-Reyes et al., 2025). Furthermore, PBIM's efficacy might be increased by using technology, such as digital tools for collaborative research. These guidelines would improve the model and increase its cross-disciplinary and cross-learning applicability(Liu & Pásztor, 2022).

Analyzing the effects of Problem-Based Inquiry Method (PBIM) on other student populations, such as students with special needs or diverse academic backgrounds, is another possible approach. Tailoring instructional tactics to maximize inclusivity may be made easier with an understanding of how this strategy interacts with individual learner variances (Seibert, 2021). Comparative research between age groups and subject areas may also show the areas in which PBIM works best. Furthermore, working together with educational policymakers may make it easier to include Problem-Based Inquiry Method (PBIM) into national curriculum (Y. Wang, 2024). Additional support for sustainable implementation would come from the creation of teacher training modules grounded in PBIM principles.

Through the introduction and empirical validation of the Problem-Based Inquiry Method (PBIM) as a cohesive pedagogical framework, this study makes a substantial contribution to the field of educational innovation. This study integrates both approaches to improve students' critical thinking, academic performance, and motivation at the same time, in contrast to earlier research that examines problem-based or inquiry-based learning separately. The integrated character of PBIM, which encourages greater cognitive involvement through methodical inquiry and real-world problem-solving, is what makes it novel. From a practical standpoint, the results indicate that PBIM can be implemented in a variety of educational settings to promote active learning and enhance student performance. By providing a model based on constructivist learning theory with practical implications for instructional design and teacher preparation, it academically links theory and practice.

This study has a number of shortcomings in spite of its advantages. First, only students from one university were included in the sample, which would have limited how broadly the results might be applied in other educational settings. Second, even though the quasi-experimental design is rigorous, participant differences that already existed cannot be completely eliminated. Third, the brief duration of the intervention might not accurately

represent the PBIM model's long-term impacts. Furthermore, subtle facets of student experiences and classroom dynamics may have been missed due to the only reliance on quantitative tools. These restrictions emphasize the necessity of exercising caution when interpreting the results and point to areas that warrant more investigation in further research.

Future studies should think about using longitudinal research to assess the Problem-Based Inquiry Method's long-term effects over several academic semesters. External validity would also be improved by broadening the study to cover other geographic areas, school kinds, and educational levels. Richer insights into how PBIM affects student engagement and learning processes may be obtained by incorporating qualitative techniques including focus groups, interviews, and classroom observations. Researchers may also investigate how well PBIM works in online and hybrid learning environments or when combined with digital tools. Finally, analyzing how PBIM affects a range of student populations, including those with special education needs, may provide insightful advice for inclusive and personalized teaching.

This study concludes by presenting and validating a novel pedagogical strategy that combines inquiry-based learning with problem-solving. By proving that the Problem-Based Inquiry Method (PBIM) may greatly enhance students' cognitive and motivational results, it advances both theory and practice. These results provide credence to a move toward learner-centered education that gives students the freedom to think critically and pursue their own learning goals. The study promotes the broad usage of the Problem-Based Inquiry Method (PBIM) and calls for more research to maximize its application. In the end, this strategy is a significant step in preparing students for complex and dynamic futures in both academic and real-world contexts.

CONCLUSION

The goal of the study was to assess how well the Problem-Based Inquiry Method improved students' academic performance, critical thinking abilities, and motivation to learn. The experimental group did much better than the control group in every assessed domain, as validated by the quasi-experimental design and thorough statistical analysis. Significant gains were seen in the data gathered from pretest and posttest evaluations, confirming the integration of inquiry-based and problem-solving methodologies. The findings highlight how creative teaching strategies might promote greater cognitive engagement and academic achievement. All things considered, this study offers strong evidence in favor of using the Problem-Based Inquiry Method to transform conventional teaching methods.

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