



The Effect of Spiritually Integrated Chemistry Learning on Learning Outcomes Moderated by Spiritual Quotient (SQ) Levels

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Abstract

Indonesian students' science performance remains low based on PISA 2022 results, particularly in abstract chemistry concepts such as acid-base. This study aims to analyze the effect of chemistry learning integrated with spiritual values on students' learning outcomes moderated by Spiritual Quotient (SQ) levels. A quasi-experimental method with a 2×2 factorial design was employed, involving 60 eleventh-grade students selected through purposive sampling. The experimental class ($n = 30$) applied Problem Based Learning (PBL) integrated with seven spiritual values (awareness, elegance, meaningfulness, transcendence, truth, peace, wisdom) through motivation, reflection, and contemplation, while the control class ($n = 30$) used PBL without spiritual values integration. Data were collected using a 20-item multiple-choice test ($KR-20 = 0.95$) and a 19-item SQ questionnaire adapted from Indaty N. (2022) based on Zohar and Marshall's (2000) theory (Cronbach's $\alpha = 0.872$). Two-Way ANOVA results revealed that spiritually integrated chemistry learning significantly improved learning outcomes ($F = 25.697, p = 0.000$). SQ level also significantly influenced learning outcomes ($F = 46.060, p = 0.001$). However, no significant interaction was found between learning model and SQ level ($p = 0.224$), indicating that both variables independently affect learning outcomes. Low SQ students in the experimental class ($M = 81.79$) achieved scores comparable to high SQ students in the control class ($M = 85.00$), suggesting that spiritual values integration can compensate for lower SQ levels. State of novelty in this study concludes that integrating spiritual values into chemistry learning enhances academic achievement and supports holistic education by connecting scientific concepts with students' life values.

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INTRODUCTION

Education plays a vital role in the development of high-quality human resources. The Indonesian National Education System highlights the importance of holistic education that encompasses cognitive, affective, and spiritual aspects. Nevertheless, current conditions reveal a discrepancy between these educational goals and the learning outcomes achieved in practice. The 2022 results of the Programme for International Student Assessment (PISA) indicate that Indonesian students' performance in science remains relatively low, with a score of 383, reflecting a decline of 13.2 points over the last five

years. This situation reflects the need to improve science learning, particularly in chemistry, where many concepts are abstract and difficult for students to understand. One topic that frequently presents learning challenges is acid-base chemistry, as it requires both conceptual understanding and analytical reasoning. Consequently, students often rely on memorization rather than developing a meaningful understanding of the concepts (Djarwo & Kafiar, 2023).

Previous studies have identified several factors that influence students' learning outcomes. One important internal factor is

Spiritual Quotient (SQ), which refers to an individual's ability to find meaning, values, and purpose in life (Zohar & Marshall, 2000). According to Zohar and Marshall (2000), SQ is the highest intelligence that underlies and integrates intellectual intelligence (IQ) and emotional intelligence (EQ). SQ enables individuals to find deeper meaning in experiences, place actions in a broader context, and distinguish right from wrong ethically.

Zohar & Marshall (2000) identified nine indicators of individuals with well-developed SQ (Afandi, 2023): (1) flexibility, (2) high self-awareness, (3) ability to face and utilize suffering, (4) ability to overcome pain, (5) quality of life inspired by vision and values, (6) refusal to cause unnecessary harm, (7) tendency to see connections between various things, (8) tendency to ask "why?" or "how?" to gain deeper understanding, and (9) independence (Maziyah et al., 2019). Zohar & Marshall (2000) emphasize that spirituality is not necessarily related to one's closeness to God; even humanists or atheists can have high spirituality. Spirituality is more about soul enlightenment the ability to interpret life positively in every event, problem, and suffering faced (Zengin, 2025).

Spirituality refers to a way of life grounded in an awareness of the transcendent dimension, which allows individuals to discover meaning and significance in various life situations. (Kurniawan & Sutoyo, 2025). Amran (2007) in Maziyah et al. (2019) formulated seven basic spiritual values found across religions: awareness, elegance, meaningfulness, transcendence, truth, peace, and wisdom. These seven values serve as the foundation for integrating spirituality into chemistry learning in this study.

Empirical evidence supports the role of SQ in academic contexts. A meta-analysis by Zhou et al. (2024) revealed a significant positive correlation between SQ and academic achievement ($r = 0.36-0.50$). In the Indonesian context, Arifin (2020) and Afrianti. & Imamuddin (2022) also found that SQ significantly contributes to students' learning outcomes.

From a pedagogical perspective, integrating spiritual values into learning activities has shown promising potential. In chemistry education, studies by Andini & Darmana (2025) and Harahap & Darmana (2025) demonstrated that

teaching materials infused with spiritual values improved both students' learning outcomes and attitudes toward learning. Alongside value integration, the use of appropriate instructional models is also essential. Problem Based Learning (PBL) has been widely recognized for promoting higher-order thinking skills and has been shown to improve critical thinking in science learning Sugiarti et al. (2023); Uluçınar (2024).

Recent studies have further confirmed that Problem-Based Learning (PBL) significantly enhances students' learning outcomes and critical thinking skills in chemistry learning (Shiddiqi et al., 2025). In addition, integrating spiritual values into learning has been shown to improve both students' cognitive achievement and learning attitudes (Aulia & Darmana, 2025). Furthermore, students' spiritual attitudes and Spiritual Quotient (SQ) have been reported to have a significant relationship with learning outcomes (Juwita et al., 2024). Therefore, integrating spiritual values and Spiritual Quotient (SQ) into Problem-Based Learning (PBL) is considered a promising approach to improve students' learning outcomes holistically. The integration of spiritual values is expected to strengthen students' conceptual understanding because it facilitates meaningful learning. By connecting scientific concepts with values and real-life contexts, students are encouraged to construct deeper understanding rather than rely on memorization, which is consistent with constructivist learning theory (Jonassen, 2011).

Nevertheless, several research gaps still exist. Previous studies have mostly investigated the integration of spiritual values and the implementation of the PBL model as separate topics rather than examining them together. Research that combines spiritual value integration with the PBL model in chemistry learning, particularly in abstract topics such as acid-base concepts, is still limited. Moreover, studies that analyze how differences in students' SQ levels influence learning outcomes remain scarce (Djarwo & Kafiar, 2023). Therefore, the scientific novelty of this study lies in integrating spiritual values within the PBL model and examining its effectiveness on students' learning outcomes based on their SQ levels.

Based on the aforementioned background, this study addresses the following research questions: (1) Does the integration of spiritual values in

chemistry learning influence students' learning outcomes? (2) Do students' SQ levels affect their learning outcomes? (3) Is there an interaction between spirituality-integrated learning and SQ levels in influencing learning outcomes?

Based on the theoretical framework, the hypotheses of this study are formulated as follows:

This study aims to examine whether a Problem-Based Learning (PBL) model in chemistry integrated with spiritual values can improve students' learning outcomes compared to the standard PBL model. In addition, this study investigates the effect of students' Spiritual Quotient (SQ) on their learning outcomes, as well as the possible interaction between two variables.

The relationship between the learning approach, students' SQ level, and learning outcomes is illustrated in Figure 1.

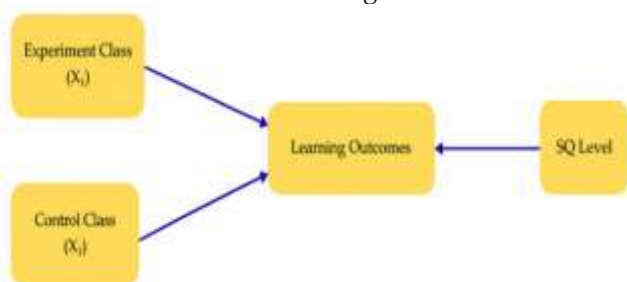


Figure 1. Path Diagram

Figure 1 illustrates the relationship between the learning model (integrated spiritual values vs. conventional), students' SQ level (high vs. low), and learning outcomes.

Based on the background, the problem of this study is whether the integration of spiritual values in chemistry learning affects students' learning outcomes based on their SQ levels

METHOD

This study employed a quantitative approach using a quasi-experimental design that involved an experimental class and a control class. Pre-tests and post-tests were administered to both groups to assess students' learning outcomes, while an SQ questionnaire was used to determine students' SQ levels (Saputri & Mardiaty, 2025)

The population of this study included all Grade XI students of SMA Negeri 2 Percut Sei Tuan, comprising six classes. The sample was determined through purposive sampling by considering the similarity of students' academic abilities. In total, 60 students were selected, with 30 students assigned to the experimental class and 30 students to the control class. Both classes were taught using the PBL model; however, the experimental class received chemistry instruction integrated with spiritual values, while the control class received the same PBL model without the integration of spiritual values.

The integration of spiritual values in the experimental class was based on seven basic spiritual values formulated by Amran (2007) in Maziyah et al. (2019): awareness, elegance, meaningfulness, transcendence, truth, peace, and wisdom. These values were integrated into three key moments in each lesson: motivation at the beginning, reflection during learning, and contemplation at the end of the lesson.

The study employed a 2 × 2 factorial design involving two factors: the chemistry learning approach (PBL integrated with spiritual values vs PBL model) and students' SQ level (high vs. low) (Sagala & Saragih, 2015). The research design is presented in Table 1.

Table 1. Anova 2x2 Research Design

Spiritual Quotient (SQ)	Chemistry Learning	
	Experiment Using Integrated Chemistry Learning Spiritual Values (X1)	Control Using Chemistry Learning (X2)
High (A1)	X1 A1	X2 A1
Low (A2)	X1 A2	X2 A2

While: X1A1 = Students academic achievement with high SQ in Experimental Class; X1A2 = Student academic achievement with low SQ in Experimental Class; X2A1 = Student academic achievement with high SQ in Control Class; X2A2 = Student academic achievement with low SQ in Control Class.

The acid-base test instrument was first valida-

ted through expert judgment by three validators and empirically tested on students who had previously studied the material, after which it was analyzed for validity, demonstrated high reliability (KR-20 = 0.95), a balanced level of item difficulty, good discrimination power, and effective distractors, indicating that it is appropriate for use (Magdalena et al., 2021) and

an SQ questionnaire adapted from Indaty (2022) consisting of 19 items based on Zohar & Marshall (2000) nine characteristics of SQ. The instrument was validated by three experts and tested on 30 students, yielding a Cronbach's alpha reliability coefficient of 0.872. Based on SQ scores, students were categorized as high SQ and low SQ.

The study was carried out over six meetings. During the first meeting, students were asked to complete the pre-test and the SQ questionnaire. The subsequent meetings were devoted to instructional activities, laboratory practicum, and the administration of the post-test. The research flow is presented in Figure 2.

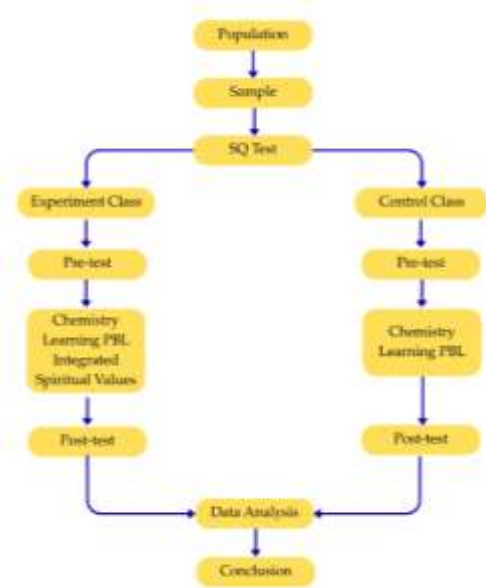


Figure 2. Research Flow

The feasibility of the PBL teaching module integrated with spiritual values was validated by three experts, consisting of a chemistry education lecturer from Universitas Negeri Medan, a chemistry education lecturer from UIN Syahada Padangsidempuan, and a chemistry teacher from SMA Negeri 2 Percut Sei Tuan. The validation process was carried out in accordance with the standards established by the Badan Standar Nasional Pendidikan (BSNP), which encompass four aspects: content feasibility, presentation

feasibility, language feasibility, and graphic feasibility.

The results of the expert validation of the PBL teaching module integrated with spiritual values based on the BSNP criteria as shown in Table 2

Table 2. Teaching Module Validation Result

Aspects	Percentage Score
Content feasibility	90.15%
Presentation feasibility	88.88%
Langue feasibility	86.11%
Graphics feasibility	91.66%

As shown in Table 2, all aspects achieved high feasibility scores. The results indicate that the PBL teaching module integrated with spiritual values meets the feasibility criteria and is appropriate for use in the learning process.

RESULTS AND DISCUSSION

Result The comparison of students' average learning outcomes based on the type of teaching materials used is shown in Figure 3.

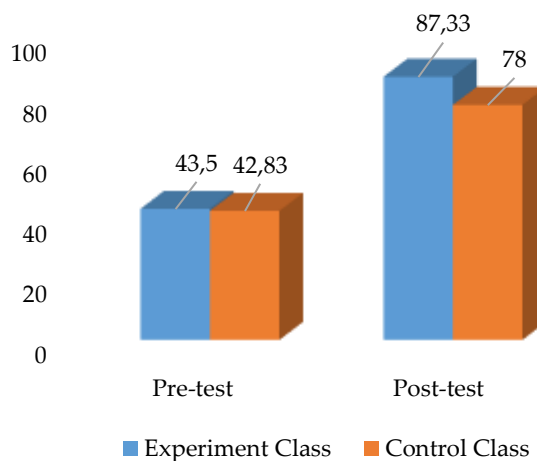


Figure 3. Average Learning Outcomes

Figure 3 indicate that students who used teaching materials integrated with spiritual values achieved higher average learning outcomes compared to those who studied using teaching materials without the integration of spiritual values.

Table 3. Distribution of Average Score of Student Learning Outcomes

Learning Materials	Student SQ Level	Average Score	Std. Error
Using Integrated Chemistry Learning Spiritual Values	High SQ Level	92.19	1.204
	Low SQ Level	81.79	2.260
Using Chemistry Learning	High SQ Level	85.00	2.041
	Low SQ Level	70.00	1.889

Based on Table 3, students with high SQ who learned using integrated chemistry learning with

spiritual values achieved the highest average score (92.19), followed by students with low SQ

(81.79). In contrast, students who learned using conventional chemistry learning obtained lower scores, with averages of 85.00 for high SQ students and 70.00 for low SQ students. These results indicate that the integration of spiritual values and students' SQ levels influence differences in learning outcomes.

A normality test was conducted as a prerequisite for the two-way ANOVA analysis shown in Table 4.

Table 4. Normality Test Kormogorov-Smirnov

	Kolmogorov-Smirnov		
	Statistic	df	Sig.
Standardized Residual for Learning Outcomes	.123	60	.025

As shown in Table 4, the Kolmogorov-Smirnov test produced a significance value of 0.025 (N = 60), indicating that the residual data were not fully normally distributed.

To further examine the distribution pattern, visual analysis using a Q-Q Plot and histogram was conducted, as shown in Figures 5 and 6.

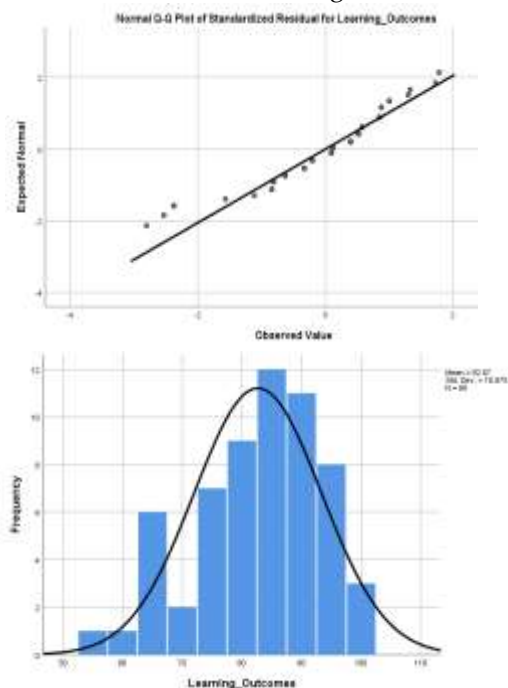


Figure 4. Q-Q Plot; Figure 5. Histogram

Table 7. Two Way ANOVA

Source	df	Mean Square	F	Sig. (p-value)
Class	1	1343.936	25.697	.000
SQ_Level	1	2408.936	46.060	.000
Class*SQ_Level	1	78.936	1.509	.224

The two-way ANOVA results (Table 7) show that the learning model significantly affects student

learning outcomes ($p < 0.05$). Students who learned using chemistry learning integrated with

Figure 4 shows that the residual data points are distributed around the diagonal line, indicating that the data distribution is close to normal. The histogram in Figure 5 also shows a relatively symmetrical distribution around the mean value.

Table 5. Normality Test Kormogorov-Smirnov Exact Approach

	Kolmogorov-Smirnov				
	Statistic	N	Mean	St. Dev	Sig.
Standardize d Residual for Learning Outcomes	.123	60	.000	.9742	.256

Based on Table 5, the Exact Sig. (2-tailed) value is 0.256 (> 0.05), which indicates that the residual data follow a normal distribution. Therefore, the normality assumption is satisfied and the data are suitable for further analysis using two-way ANOVA.

After the normality test, a homogeneity test was conducted using Levene's test to examine whether the variance among groups was equal. The results of the homogeneity test are shown in Table 6.

Table 6. Homogeneity Test

Levene's Test of Equality of Error Variances				
Dependent variable : Learning Outcomes				
Levene's Statistic	df1	df2	Sig.	
.581	3	56	.630	

As shown in Table 6, the significance value obtained was 0.630 (> 0.05), indicating that the variance among groups is homogeneous. Therefore, the homogeneity assumption required for the two-way ANOVA analysis is satisfied.

After all statistical assumptions were met, hypothesis testing was conducted using a two-way ANOVA to examine the effects of the learning model and students' SQ levels on learning outcomes. shown in Table 7

learned using chemistry learning integrated with

spiritual values achieved higher scores than those who learned without spiritual value integration. In addition, SQ level also significantly affects learning outcomes ($p < 0.05$). However, the interaction between the learning model and SQ level was not significant ($p = 0.224$), indicating that both variables independently influence students' learning outcomes.

Discussion

The findings indicate that chemistry learning integrated with spiritual values has a statistically significant main effect on students' learning outcomes. Students who experienced learning with integrated spiritual values achieved higher scores than those who learned without such integration. It is important to emphasize that both the experimental and control groups in this study implemented the same instructional model, namely Problem Based Learning (PBL). The key difference lies in the integration of spiritual values, which was applied only in the experimental group, while the control group received PBL without spiritual value integration. Therefore, the observed effect should be attributed specifically to the integration of spiritual values within the PBL framework, rather than differences in the instructional model itself.

The integration of spiritual values enriches the learning process by systematically linking scientific concepts with reflective and meaningful learning experiences. In this study, the spiritual dimension includes seven universal values, namely awareness, elegance, meaningfulness, transcendence, truth, peace, and wisdom (Amran, 2007, in Maziyah et al., 2019). When embedded within PBL, these values encourage students to connect chemistry concepts with real life meaning and ethical awareness, thereby strengthening conceptual understanding. More specifically, in the context of acid–base learning, the integration of spiritual values helps students understand abstract concepts more easily because the material is illustrated through everyday life situations. For example, acid–base concepts are related to daily phenomena such as food, household substances, and environmental contexts, allowing students to construct meaning based on familiar experiences. This contextualization reduces the level of abstraction and enables students to grasp the concepts more effectively.

Through the contemporary values based edu-

cation perspective, the contribution of spiritual value integration within PBL extends beyond general claims of meaningful learning. Recent studies have shown that integrating values into subject learning enhances cognitive engagement and academic performance (Meyer et al., 2024; Lubis & Darmana, 2024; Murhayati et al., 2022).

However, this relationship is not self-explanatory and should be understood through several mechanisms. First, value integration increases students' attentional engagement and intrinsic motivation, as learning becomes personally relevant (Ryan & Deci, 2020). Second, it promotes metacognitive reflection. Third, it strengthens the connection between abstract chemistry concepts and real life contexts, thereby reducing cognitive abstraction. Fourth, it enhances emotional engagement and self-regulation, which are essential in sustaining inquiry processes in PBL environments. These mechanisms provide a more rigorous explanation for the observed main effect of spiritual value integration within PBL.

The results also reveal a statistically significant main effect of SQ on students' learning outcomes. Students with higher SQ tend to demonstrate stronger self awareness, intrinsic motivation, and persistence in the learning process. Recent empirical studies confirm that SQ is positively associated with academic engagement and performance (Shafiee et al., 2025; Zhou et al., 2024; Espinosa & González, 2024). In the context of PBL, these characteristics are particularly relevant, as students are required to engage in critical thinking, problem solving, and reflective evaluation. Therefore, SQ should be interpreted as an independent predictor of academic achievement.

Importantly, the analysis does not support a significant interaction effect between the integration of spiritual values in PBL and SQ level. This finding must be interpreted carefully to avoid overgeneralization. The absence of interaction indicates that the effectiveness of PBL with integrated spiritual values is consistent across different SQ levels, rather than being strengthened or weakened by them. In statistical terms, the effects of spiritual value integration and SQ are additive rather than multiplicative. This interpretation is fully aligned with the ANOVA results and prevents misinterpretation of SQ as a moderating variable.

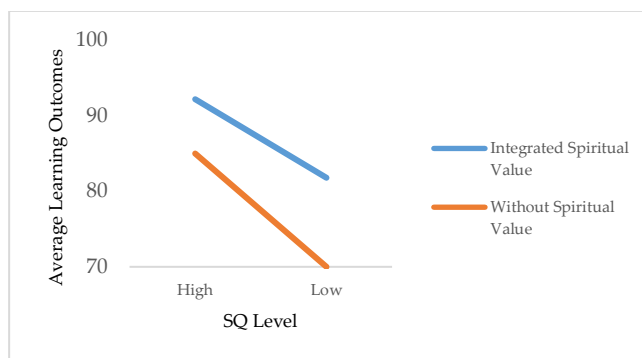


Figure 6. Interaction between Learning Model and SQ on Learning Outcomes

The interaction graph in Figure 6 further supports this conclusion. Although students with both high and low SQ levels benefited from PBL with integrated spiritual values, the relatively parallel pattern of the lines indicates the absence of a meaningful interaction effect. This visual evidence reinforces the statistical findings and supports a more precise interpretation.

Pedagogically, these results suggest that integrating spiritual values into PBL creates a more meaningful and engaging learning environment that supports both cognitive and affective development. Importantly, the use of real life illustrations in acid–base learning not only enhances conceptual clarity but also increases students' relevance perception toward the material. In addition, the absence of interaction implies that this approach is inclusive, as it benefits students regardless of their SQ level.

Overall, these findings indicate that the integration of spiritual values into chemistry learning has the potential to enhance students' academic performance while supporting holistic education that integrates cognitive and affective dimensions. This result aligns with Suprpto (2025), who emphasizes that spiritual, intellectual, emotional, and social intelligences collectively contribute to educational development, while Taupik (2025) highlights that SQ plays a direct and independent role in influencing learning outcomes.

CONCLUSION

This study shows that integrating spiritual values within PBL significantly improves students' learning outcomes, while SQ also contributes independently. As both groups employed the same PBL model, the observed effect can be attributed specifically to the integration of spiritual values as an effective instructional component. The absence of an

interaction effect indicates that instructional design and SQ operate through independent pathways rather than as moderating factors. The novelty of this study lies in demonstrating that integrating spiritual values functions as a systematic and inclusive pedagogical strategy that enhances chemistry learning without depending on students' SQ levels. Although descriptive patterns suggest potential benefits for students with lower SQ, this should be interpreted cautiously.

RECOMMENDATION

The integration of spiritual values can help students connect scientific concepts with life values, thereby fostering both academic achievement and character development. Furthermore, future studies are encouraged to examine the implementation of spirituality-integrated learning in different subjects, educational levels, and larger sample sizes to obtain more comprehensive findings.

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