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Motivation and Meaning-Making in Science Learning: Students' Experiences in an Indonesian *Pesantren*

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Abstract. Science education in Islamic boarding schools (*pesantren*) presents a unique context where formal academic learning is integrated with intensive religious education. While *pesantren* play an important role in shaping students' intellectual and moral development, limited research has explored how students experience science learning within this dual educational structure. This study aims to examine students' motivation toward science learning, the influence of the *pesantren* learning environment, and how students construct meaning around science knowledge. A qualitative approach was employed using semi-structured interviews with four senior high school students enrolled in an Indonesian *pesantren*. The interview data were analyzed using thematic analysis to identify recurring patterns in students' learning experiences. The findings reveal three major themes. First, students' motivation toward science learning is shaped by both intrinsic interest and perceived competence, particularly when students encounter challenging subjects such as physics and chemistry. Second, the dual academic–religious structure of the *pesantren* environment influences students' engagement with science, as they must balance formal school learning with intensive religious activities. Third, students interpret science learning through broader personal and religious meaning systems, often viewing scientific knowledge as a way to understand natural phenomena and appreciate divine creation. These findings suggest that science learning in *pesantren* contexts involves a dynamic interaction between motivation, institutional learning structures, and meaning-making processes. Integrating science education with students' cultural and religious perspectives may therefore enhance engagement and deepen the relevance of science learning within an Islamic educational environment.

Keywords: *Pesantren*; meaning-making; science learning motivation; secondary education.**Abbreviations:** Self-Determination Theory (SDT), Islamic Boarding School (*Pesantren*).

INTRODUCTION

Science education is a fundamental component of secondary education because it develops the scientific literacy and problem-solving skills students need to make informed choices in contemporary society. Students with high motivation to learn science will show better academic performance, greater study persistence, and greater schoolwork engagement, according to research findings [1], [2]. The level of student participation in scientific studies depends on three motivational factors: their internal enjoyment of science, their belief in their abilities, and their assessment of the value of scientific tasks based on research findings [1], [2]. Studies across different educational environments show that students with higher intrinsic motivation and self-efficacy in science studies work harder and show greater determination, resulting in better academic performance [1].

Most scientific studies about science motivation research have been conducted in educational settings that teach standard academic programs. The Indonesian *pesantren* system provides a unique educational setting that prioritizes religious instruction as its primary focus while also teaching science and other subjects through its academic program. The combination of religious studies and standard academic programs enables students to develop various reasons for studying science, including their spiritual objectives, community requirements, and professional ambitions.

The current research on *pesantren* science education focuses on institutional strategies and curriculum integration models rather than on how students develop motivation to learn. Research on integrated learning methods that combine science with religious studies describes teaching methods that link scientific knowledge to religious traditions. Still, it fails to examine how students understand scientific concepts and what motivates them to learn [3]. Existing research investigates how Islamic knowledge and scientific research intersect in *pesantren* education. Still, the conceptual frameworks used in these studies fail to show how students experience science learning in real life [4].

International science education research demonstrates how students' motivational beliefs interact with their learning environments and instructional design to determine their academic engagement. The research

demonstrated that inquiry-based learning increases intrinsic motivation by enabling students to explore their learning in an active way [5]. The mixed-methods research demonstrates that different student motivation profiles, as assessed by intrinsic motivation levels, self-efficacy, and task value, are strongly connected to students' science classroom engagement and academic achievement [6]. The research results demonstrate that both individual motivational factors and learning environment factors must be analyzed when researchers study science learning processes.

Religious educational institutions, such as *pesantren*, face unique challenges when their students pursue science education. Research findings indicate that religious school students view science as beneficial when it teaches skills they can use to serve their community and participate in religious outreach activities through community development efforts [7]. The existing research provides insufficient evidence on how *pesantren* students express their motivations for learning science and how they handle academic difficulties arising from their boarding school environment.

Additionally, the *pesantren* environment presents three main challenges to educational progress: it restricts access to learning materials, schedules time for religious activities, and provides different levels of science teaching assistance, which affects how students perceive difficulty and relevance and their ability to stay motivated. The research study found that students' motivational perspectives towards educational activities have not been explored through systematic investigation, although existing descriptive studies examine the contextual factors of *pesantren* curricula.

This study uses Self-Determination Theory (SDT) as its theoretical foundation because this theory explains how students become motivated through their three basic psychological needs which include competence (the ability to accomplish tasks), autonomy (the ability to direct their learning process), and relatedness (the experience of emotional connection and backing from important people) [8], [9]. When students have their needs met in a learning space, they will build internal drive that enables them to keep going through difficult times while they find educational value in what they learn. In science education research, SDT provides a framework for understanding how students' motivations affect their learning experiences through classroom activities and teaching methods, as well as their interactions with others [8], [9]. The established routines, religious and academic responsibilities, and special teaching methods of *pesantren* settings make SDT an effective framework for studying how students develop motivation in science learning environments.

In addition, this study used Meaning-Making Theory to analyze how students connect their science learning to their personal beliefs, identities, and overall life goals. According to Meaning-Making Theory, people desire to create understanding of their life experiences through the development of personal and cultural meaning systems that emerge when they encounter learning situations shaped by their values, beliefs, and fundamental existential issues [10], [11]. In *pesantren*, religious education environments, students discover the academic value of scientific studies that operate as educational endeavors and offer them paths to serve their communities, fulfill their religious duties, and assist in da'wah activities. Through meaning-making frameworks, this research investigates how students construct personal and spiritual meaning from science education and how these meaning-making processes affect their motivational patterns under different environmental limitations [10], [11].

To address these gaps, the present study employs a qualitative approach to explore the motivations and learning challenges of senior high school students in science within an Indonesian *pesantren*. Specifically, this study explores (1) How do *pesantren* students experience motivation and perceived competence in learning science?; (2) How does the *pesantren*'s dual academic-religious structure shape students' engagement with science learning?; and (3) How do students interpret and integrate science learning into their personal, religious, and future-oriented meaning systems?.

METHODS

Study area

The present study was conducted in a selected *pesantren* in Indonesia that provides integrated education for senior high school students, particularly those enrolled in the natural sciences (IPA) track. Students at this educational institution study science subjects through the national curriculum, which includes physics, biology, and chemistry, while they learn religious studies that comprise Qur'anic education and classical Islamic texts, and dedicated evening study sessions which are customary in *pesantren* educational systems [12], [13]. The *pesantren* operates with strict daily schedules because daytime classes are used for formal science instruction, and religious studies continue from evening until nighttime, which enables students to achieve both academic and religious development through their dual curriculum studies.

Islamic education institutions in dual educational systems operate according to their mission to create programs that combine religious education with contemporary scientific knowledge to prepare students for

their religious duties and social responsibilities [13], [14]. Science education research shows that students' engagement and academic performance depend on their motivational factors, which include self-efficacy, task value, and intrinsic interest [15], [16]. The elements of motivation and dedication to science learning, science achievement, and scientific career goals represent essential elements that guide how students handle educational difficulties.

Students who believe they can complete academic work will persist in their studies and engage with scientific material throughout secondary school, according to research, which shows self-efficacy as their main predictor of success [18]. In environments where academic demands coexist with strong religious commitments, motivational regulation may become more complex as students must allocate time and cognitive resources across multiple domains of learning.

The *pesantren* educational system established its focus on religious studies, yet modern educational discussions show new initiatives which seek to teach science through methods that respect Islamic beliefs and cultural perspective [9], [14]. The study of how students view science together with religious beliefs shows that students who see scientific knowledge as compatible with their religious beliefs display more positive science attitudes and greater motivation to study science [5]. This suggests that belief systems may function as an important contextual factor influencing science learning experiences in religious educational settings.

The factors, which include instructional time and learning environment, together with institutional expectations, work together to shape students' motivation to learn science [17]. The religious study sessions, which take place during evening hours in *pesantren* settings, create time restrictions that prevent students from getting enough rest and studying on their own, thus affecting their ability to participate in daytime science classes. Research conducted across various educational systems demonstrates that the combination of school settings and organizational frameworks results in different science motivation levels and student engagement patterns for students [18].

The *pesantren* examined in this study, therefore, represents a critical site for exploring how high school (MA) IPA students negotiate and construct meaning around science learning within a dual curriculum environment that combines religious commitments with national academic standards. By situating the research in this context, the study contributes to broader science education discussions on how motivation, belief systems, and institutional structures interact to shape students' engagement with science across culturally and educationally diverse settings [5], [15].

Procedures

Participant Selection

The researcher used purposive sampling to select participants who needed direct experience of scientific learning in religious and academic integrated study environments. Researchers used this sampling method in qualitative educational studies to select participants who possess deep knowledge of the research topic, which they will help to investigate [19], [20]. The selected participants were senior secondary students in the science track who had completed at least one year of science instruction at the institution, ensuring sufficient exposure to both laboratory and classroom-based learning [21].

Data Collection

Researcher used semi-structured interviews to gather data because this method enables them to examine participant views while keeping core questions uniform across the study [20], [21]. The interview protocol focused on three major areas: (1) how students experience autonomy, competence, and relatedness in science learning within a *pesantren* context; (2) how the dual academic–religious structure shapes their motivational processes and engagement; and (3) how students construct personal and religious meaning around science learning, particularly in relation to their future aspirations and da'wah responsibilities [22]. The interview domains have been matched with Self-Determination Theory and Meaning-Making Theory to establish research design and analytical focus through this theoretical framework. Researchers use semi-structured interviews to conduct in-depth studies of student beliefs and emotions and their educational experiences.

Each interview lasted approximately 30-45 minutes and was conducted in a quiet room within the school to ensure comfort and confidentiality. With participants' consent, interviews were audio-recorded and later transcribed verbatim to preserve the authenticity of students' responses [20]. Field notes were also taken during and immediately after interviews to document non-verbal cues and contextual factors that could support data interpretation [23].

Data analysis

Thematic analysis was used to examine the data because it helps researchers find patterns of meaning in qualitative data that show how students experience and understand things [20]. The analysis started with multiple readings of interview transcripts to achieve data familiarization, which researchers used to create

initial coding that identified important parts of the transcript, which showed how participants viewed their learning challenges and their scientific learning experiences inside the pesantren environment [20], [21].

The researcher established wider thematic groups that contained all coded elements that showed common patterns among different participants. The researchers conducted continuous transcript comparison to verify that they established themes based on actual data instead of their personal assumptions [16], [21]. Themes were reviewed and refined to ensure internal coherence and clear distinctions between categories, a key step in ensuring analytic rigor in qualitative research [20].

To enhance the trustworthiness of the findings, the researcher conducted iterative checks between raw data, codes, and themes, and maintained an audit trail documenting analytic decisions throughout the process [15], [24]. This systematic approach strengthens credibility and ensures that interpretations accurately reflect students' lived experiences in learning science within a religious educational setting [17].

RESULTS AND DISCUSSION

This study explored *pesantren* students' experiences of motivation, learning challenges, and meaning-making in science education. Through thematic analysis of interview data from four participants, several patterns emerged regarding how students engage with science learning within the *pesantren* environment. The findings are organized around the three research questions of this study. Below, the researcher provides Table 1.

Table 1. Themes and Subthemes Emerging from Interview Data.

Theme	Subtheme	Description of Findings	Participant s
Motivation and perceived competence in science learning	Intrinsic interest in science	Some students expressed genuine curiosity toward certain science topics, such as biology and natural phenomena.	A
	Extrinsic academic motivation	Students sometimes studied science primarily because of assignments and examinations.	B, C
	Perceived difficulty in science subjects	Physics and chemistry were often perceived as difficult because of calculations and abstract concepts.	B
	Positive learning experiences	Successful learning experiences, such as laboratory activities, strengthened students' confidence.	D
<i>Pesantren</i> learning structure and science engagement	Limited time for science learning	<i>Pesantren</i> activities reduced the time available for studying science subjects.	B, C
	Balancing academic and religious responsibilities	Students must divide their attention between school learning and religious activities.	A, C
	Institutional priorities in learning	Religious studies were often perceived as the main focus of education in <i>pesantren</i> .	C, D
Meaning-making of science learning	Science as appreciation of God's creation	Students viewed science as a way to understand the natural world and appreciate divine creation.	B
	Integration of science and religion	Some students related scientific concepts to religious teachings.	B, D
	Practical relevance of science	Science knowledge was perceived as useful for everyday life.	C
	Science for community and da'wah	Students believed science could help explain natural phenomena to society.	A

Note: Data were derived from semi-structured interview transcripts with pesantren students (participants coded as A-D).

Students' Motivation and Perceived Competence in Learning Science

The interviews revealed that students demonstrated diverse motivational orientations toward science learning. Several participants expressed intrinsic interest in particular scientific disciplines, especially biology, because the subject enabled them to explore living organisms and understand natural phenomena. This finding suggests that curiosity remains an important driver of engagement with science learning among pesantren students.

"I like biology because learning about living things is fascinating." (Student A)

At the same time, students also reported extrinsic forms of motivation. Learning activities were frequently influenced by external academic demands such as assignments, examinations, and classroom expectations.

"Usually, I study science because I have homework or because I have an exam coming up." (Student B)

The coexistence of intrinsic and extrinsic motivation reflects the multidimensional nature of students' engagement with science. According to Self-Determination Theory, intrinsic motivation tends to promote deeper learning and sustained engagement, whereas extrinsic motivation may encourage participation when external requirements are present. In the pesantren context, both forms of motivation appear to operate simultaneously, shaping students' approaches to science learning.

Students' perceptions of competence also emerged as a significant factor influencing their motivation. Physics and chemistry were commonly viewed as challenging subjects because they involve mathematical calculations, formula manipulation, and abstract concepts.

"Physics and chemistry can sometimes feel difficult because there's so much maths involved." (Student B)

These perceptions are consistent with previous studies indicating that students often experience lower self-efficacy in science subjects that require strong quantitative reasoning. When students perceive a subject as difficult, their willingness to engage and persist may decrease. Conversely, successful learning experiences can strengthen confidence and foster greater participation.

"It feels great to take part in the practical sessions and successfully understand the results." (Student D)

Practical activities appeared to provide students with opportunities to experience mastery and achievement, which enhanced their sense of competence. This finding aligns with social cognitive perspectives emphasizing that successful learning experiences contribute to the development of self-efficacy and academic motivation. Therefore, students' motivation to learn science in pesantren is shaped not only by their interest in scientific content but also by their confidence in their ability to understand and apply scientific concepts.

Influence of the Pesantren's Dual Academic-Religious Structure on Science Learning

Students consistently emphasized that learning science in pesantren occurs within a structured environment that combines formal schooling with intensive religious activities. These routines often limit the time available for studying science.

"There are loads of activities at the Islamic boarding school, including Quran study and other boarding school activities." (Student B)

Participants also explained that they must constantly balance their academic responsibilities with religious commitments.

"We have to divide our time between school lessons and boarding school activities." (Student C)

The findings indicate that students experience a unique educational setting characterized by dual responsibilities. Unlike students in conventional schools, pesantren students participate not only in formal classroom learning but also in various religious programs, including Qur'anic recitation, religious studies, congregational prayers, and other boarding school activities. As a result, the amount of time and energy available for studying science outside the classroom may be more limited.

In this context, religious studies are often perceived as the primary educational focus, while science subjects are positioned alongside other general academic subjects

"Religious studies are indeed given priority at Islamic boarding schools." (Student D)

This perception reflects the historical mission of pesantren as institutions primarily dedicated to the transmission of Islamic knowledge and the development of religious character. Consequently, students may perceive religious subjects as carrying greater institutional and cultural significance than science subjects. Such perceptions can influence how students allocate their learning efforts and prioritize academic tasks.

Nevertheless, the findings do not suggest that science learning is marginalized within the pesantren environment. Rather, students described a continuous process of negotiating and balancing multiple educational demands. The dual academic-religious structure appears to create both challenges and opportunities for science learning. On one hand, intensive religious activities may reduce study time and increase academic workload. On the other hand, the structured daily routines characteristic of pesantren can foster discipline, responsibility, and time-management skills that support academic achievement.

These findings are consistent with previous studies on Islamic boarding schools, which have highlighted the complexity of integrating religious and general education within a single institutional framework. The coexistence of these educational domains requires students to navigate multiple learning expectations and identities simultaneously. Consequently, students' engagement with science cannot be understood solely through individual factors such as motivation or competence, but must also be examined within the broader institutional context in which learning takes place.

Furthermore, the findings suggest that the pesantren environment shapes students' experiences of science learning not only through curricular arrangements but also through the values embedded within daily life.

Students are encouraged to pursue both religious and general knowledge, reflecting the broader educational philosophy of many contemporary pesantren that seek to produce graduates who are intellectually capable and spiritually grounded. Therefore, science learning in pesantren should be understood as part of a holistic educational experience in which academic development is closely interconnected with religious formation and character education.

Students' Meaning-Making of Science Learning

Beyond academic motivation, students interpreted science learning through a broader framework of personal, practical, and religious meaning. Rather than viewing science solely as a school subject, participants described science as a means of understanding the natural world and reflecting on the existence and greatness of God.

"When we study science, we can see how the natural world was created." (Student B)

This finding suggests that students do not perceive science and religion as separate or competing domains of knowledge. Instead, scientific inquiry is understood as a pathway for exploring and appreciating the complexity of creation. For these students, learning about natural phenomena strengthens not only their scientific understanding but also their sense of spiritual awareness. The natural world is viewed as evidence of divine creation, allowing science learning to become an activity that carries religious significance. Students also described connections between scientific concepts and Islamic teachings.

"Sometimes there are natural phenomena described in the Qur'an." (Student D)

The participants' responses indicate that they actively seek relationships between classroom science and religious knowledge. Rather than positioning science and religion in opposition, students often interpret scientific explanations through a framework informed by Islamic beliefs. This tendency reflects the educational culture of pesantren, where religious perspectives are deeply embedded in students' daily learning experiences. As a result, science learning may contribute to a more integrated worldview in which scientific and religious knowledge are perceived as complementary sources of understanding.

"Science is important for everyday life, such as health." (Student C)

Participants recognized that scientific knowledge provides useful explanations for everyday phenomena and supports informed decision-making in areas such as health, technology, and environmental awareness. This finding suggests that students perceive science as relevant beyond examination requirements or classroom achievement. The practical applications of science help students connect abstract concepts to real-world situations, making science learning more meaningful and personally relevant. Interestingly, some participants also associated science learning with broader social and community-oriented purposes.

"If we understand science, we can explain scientific phenomena to the public." (Student A)

This perspective demonstrates that students view scientific literacy as a resource that can benefit others. Scientific knowledge is not only considered valuable for personal academic success but also for contributing to society through communication, education, and public engagement. Within the pesantren context, such views may be linked to broader values of service, responsibility, and community contribution that are often emphasized in Islamic education.

Taken together, these findings reveal that students construct multiple layers of meaning around science learning. Science is understood simultaneously as a source of academic knowledge, a practical tool for everyday life, a means of understanding God's creation, and a resource for serving society. This multidimensional interpretation differs from perspectives that frame science learning solely in terms of achievement, grades, or future careers. Instead, students' meanings are shaped by the unique educational environment of pesantren, where religious values, intellectual development, and social responsibility are closely interconnected.

The findings also suggest that science learning in pesantren may foster a holistic understanding of knowledge. Students' narratives indicate that scientific inquiry is not viewed as detached from moral or spiritual concerns but is embedded within broader questions about human existence, faith, and social responsibility. Consequently, science education in pesantren has the potential to support both scientific literacy and the development of meaningful connections between knowledge, belief, and everyday practice.

Discussion

The findings of this study highlight the complex relationship between motivation, institutional context, and meaning-making in science learning within pesantren environments. Rather than functioning as independent factors, these dimensions interact to shape how students engage with science, perceive their learning experiences, and construct the value of scientific knowledge. The findings suggest that science learning in pesantren cannot be understood solely through cognitive or academic perspectives but must also be examined through the broader educational, cultural, and religious contexts in which students are situated.

First, students' motivation, together with their perceived competence in science subjects, determines their level of scientific engagement. Students who experience interest together with a sense of competence, according to Self-Determination Theory (SDT), will show increased engagement with their learning tasks. Students who find physics and chemistry to be difficult subjects will experience a drop in their motivation to study. The research shows that students who feel competent in science subjects tend to maintain their engagement with learning activities, as shown in previous research studies [9], [25]. Perceived competence has been widely identified as a key predictor of persistence and learning effort, particularly in challenging subjects such as science and mathematics [26].

The present findings further indicate that perceptions of competence are closely associated with the characteristics of specific science subjects. Participants frequently described physics and chemistry as difficult because these subjects involve mathematical calculations, abstract reasoning, and conceptual complexity. Such perceptions may influence students' willingness to invest effort in learning activities and their confidence in overcoming academic challenges. Within the pesantren context, these perceptions may become particularly significant because students have limited time to revisit difficult concepts outside formal classroom instruction. Consequently, students who experience low perceived competence may be more vulnerable to disengagement when faced with challenging scientific content.

Conversely, students who reported positive experiences during practical activities demonstrated higher levels of confidence and engagement. Laboratory activities and hands-on learning experiences appeared to provide opportunities for mastery experiences, which are recognized as important sources of self-efficacy development. These findings are consistent with previous studies suggesting that successful learning experiences strengthen students' confidence and promote sustained participation in science learning [25], [26]. Therefore, science educators in pesantren may benefit from providing learning experiences that enhance students' perceptions of competence through practical investigations, collaborative learning, and constructive feedback.

The second part of the research shows that the pesantren educational system develops a dual educational structure that creates distinctive learning conditions for students studying science. The study found that this institutional framework restricts students' time for scientific study while simultaneously shaping their academic priorities across various subjects. Students must continuously negotiate between formal school responsibilities and religious commitments, resulting in unique patterns of engagement with science learning. Students will experience different motivational states based on how this situation unfolds. Previous research on Islamic boarding schools in Indonesia shows that pesantren develop their educational systems through the integration of religious studies and national curriculum requirements, creating a distinct learning environment that affects how students develop their educational goals [27], [28].

The findings suggest that the influence of the pesantren structure extends beyond simple time allocation. Religious learning activities are often perceived as the primary focus of educational life within the boarding school environment, while science is positioned alongside other general academic subjects. This perception may shape students' prioritization of learning activities and influence the amount of attention devoted to science-related tasks. However, the findings do not indicate that science is neglected. Rather, students engage in a continuous process of balancing multiple educational expectations. This balancing process reflects the broader mission of contemporary pesantren, which seek to cultivate both religious competence and academic achievement.

Interestingly, the structured routines characteristic of pesantren may function as both a challenge and a resource for science learning. On the one hand, intensive religious activities may reduce the amount of available study time and contribute to academic workload. On the other hand, the disciplined environment of the boarding school may foster self-regulation, responsibility, and time-management skills that support academic success. These findings suggest that institutional structures influence science learning not only by creating constraints but also by providing resources that shape students' learning behaviors. Consequently, understanding science learning in pesantren requires attention to the broader educational ecology in which students develop their academic identities.

The study also shows that students use their religious beliefs to understand scientific concepts better. The Meaning-Making Theory explains how students connect their academic learning to their personal beliefs and life purposes. In the pesantren context, students view science as a means to understand divine creation and develop their social comprehension skills. The study shows that students find science learning to be more valuable when their religious beliefs and social values are included in their education. Students use meaning-making processes to link their academic knowledge with their religious beliefs and personal identity because this process helps them build connections in religious educational settings [10], [29].

This finding represents one of the most significant contributions of the study. Participants did not view science merely as a collection of facts, theories, or formulas to be memorized for examinations. Instead,

science was interpreted as a way of understanding the natural world and appreciating the complexity of creation. Students frequently associated scientific knowledge with reflections on the greatness of God, suggesting that science learning carries spiritual significance within the *pesantren* environment. Such interpretations indicate that scientific inquiry and religious belief are not perceived as competing domains of knowledge but as complementary ways of understanding reality.

Furthermore, students actively connected scientific concepts with religious teachings, particularly when discussing natural phenomena described in Islamic sources. This tendency reflects the broader educational culture of *pesantren*, where knowledge is often understood through an integrative framework that seeks harmony between religious and scientific perspectives. Rather than separating science from faith, students appeared to construct an interconnected understanding of both domains. This finding supports arguments within Islamic educational scholarship that scientific knowledge can contribute to the development of religious awareness when learners are encouraged to reflect on the relationship between natural phenomena and spiritual values.

The findings also reveal that students attribute practical and social meanings to science learning. Participants emphasized the importance of science in everyday life, including health, environmental awareness, and understanding common phenomena encountered in society. Beyond personal benefits, some students viewed scientific knowledge as a resource for educating others and contributing to the wider community. This perspective suggests that students perceive science as having social value and relevance beyond academic achievement. Such interpretations align with the broader educational goals of *pesantren*, which emphasize social responsibility, service, and contributions to society.

From a theoretical perspective, these findings extend existing discussions of motivation and engagement in science education. While Self-Determination Theory emphasizes the importance of competence, autonomy, and relatedness in promoting engagement, the present findings suggest that students' motivation may also be strengthened when scientific knowledge is perceived as meaningful within their broader religious and social worldviews. In other words, engagement with science is not shaped solely by psychological needs but also by the extent to which students can integrate scientific learning into their personal belief systems and life purposes. This observation highlights the importance of considering cultural and religious contexts when examining science learning in faith-based educational settings.

Taken together, the findings demonstrate that science education in *pesantren* schools occurs through an active process that combines student motivation, institutional structures, and meaning-making processes. Students' engagement with science is shaped not only by their interest and competence but also by the educational environment in which they learn and the meanings they assign to scientific knowledge. Understanding these relationships can help educators develop science teaching approaches that respect both academic requirements and the cultural traditions of students. Science learning experiences that support competence, acknowledge institutional realities, and encourage meaningful connections between scientific concepts, religious values, and everyday life may enhance students' engagement and learning outcomes. Therefore, effective science education in *pesantren* should be understood as a holistic endeavor that integrates cognitive, motivational, social, and spiritual dimensions of learning.

CONCLUSION

The study explored how *pesantren* students develop their motivation to learn science while facing educational obstacles and establishing their understanding of scientific concepts. The research discovered that students build their connections to science education through their combination of motivational elements and institutional frameworks and their personal systems of understanding. Students will study science subjects based on their internal motivation and essential abilities. The dual academic-religious system of *pesantren* creates an educational environment where students must manage their time between conventional scientific studies and religious commitments. Students connect scientific concepts with religious beliefs. They view scientific knowledge as a method to comprehend natural processes and recognize divine creation. Science education in *pesantren* contexts requires schools to understand students' motivational needs, their learning environments, and their religious belief systems. Students will study science more effectively when schools connect scientific studies with their cultural and religious traditions. Future research will investigate how schools can teach science through scientific methods while helping students develop their religious understanding at *pesantren* schools.

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