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# Integration of Religious Studies and Science in PAI Learning: A Transdisciplinary Approach

**Rahmad Nasution, Mohammad Al Farabi, Sri Aqilah Maulida, Kiki Tandra Pranata, Rizki Nurbaiti Simanjuntak**

Universitas Islam Negeri Sumatera Utara, Indonesia

**Corresponding Author:**
Sri Aqilah Maulida, e-mail : sriaqilah0301212107@uinsu.ac.id

**Abstract.** The integration of religious sciences and science has become a key focus in the development of education at Islamic Higher Education Institutions (PTKI), such as UIN Sumatera Utara. This study aims to examine the implementation of a transdisciplinary approach in Islamic Religious Education (PAI) learning at UIN Sumatera Utara, investigating how the integration of religious knowledge and science is applied in the curriculum and teaching processes. A qualitative approach with field research was employed, involving classroom observations, in-depth interviews with lecturers, students, and curriculum managers, as well as document analysis. The findings indicate that the transdisciplinary approach has been implemented through the use of digital technology, contemporary scientific studies, and the integration of classical literature with modern scientific knowledge. Students showed high enthusiasm for this approach, leading to increased active participation, critical thinking skills, and a more contextual understanding of religious teachings. This research contributes to the development of a more holistic and adaptive PAI learning model, strengthening the relationship between religion and science in Islamic education at PTKI.

***Keyword***: *Islamic Religious Education; Integration; Religious knowledge; Science; Transdisciplinary approach*

**Abstrak.** Integrasi ilmu agama dan sains menjadi fokus utama pengembangan pendidikan di Perguruan Tinggi Keagamaan Islam (PTKI), seperti UIN Sumatera Utara. Penelitian ini bertujuan untuk mengkaji implementasi pendekatan transdisipliner dalam pembelajaran Pendidikan Agama Islam (PAI) di UIN Sumatera Utara, dengan meneliti bagaimana penggabungan ilmu agama dan sains diterapkan dalam kurikulum dan proses pembelajaran. Metode yang digunakan adalah pendekatan kualitatif dengan studi lapangan, yang melibatkan observasi kelas, wawancara mendalam dengan dosen, mahasiswa, dan pengelola kurikulum, serta analisis dokumen terkait. Temuan penelitian menunjukkan bahwa pendekatan transdisipliner telah diterapkan melalui penggunaan teknologi digital, kajian ilmiah kontemporer, dan integrasi literatur klasik dengan ilmu pengetahuan modern. Mahasiswa menunjukkan antusiasme yang tinggi terhadap pendekatan ini, yang meningkatkan partisipasi aktif, kemampuan berpikir kritis, dan pemahaman keagamaan yang lebih kontekstual. Penelitian ini berkontribusi pada pengembangan model pembelajaran PAI yang lebih holistik dan adaptif terhadap perkembangan ilmu pengetahuan, serta memperkuat hubungan antara agama dan sains dalam pendidikan Islam di PTKI.

***Kata Kunci***: *Integrasi; Ilmu agama; Pendidikan Agama Islam; Pendekatan transdisipliner; Sains*

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## Introduction

In Indonesia, the integration of religious sciences and science has become a key focus in the development of epistemology in Islamic education at Islamic higher education institutions which embraces an integrative and transformative scientific paradigm. The advancement of modern knowledge, especially in science and technology, demands a learning approach that is not only textual and normative but also contextual, analytical, and relevant to the dynamics of life in the 21st century. The development of religious sciences and science in Islamic education, especially in State Islamic Universities (UIN), faces unique challenges, as the role of religion in shaping students' thinking often contrasts with the demands of the modern age, which is heavily technology-based (Abdullah, 2006; Yulanda, 2019). Therefore, it is crucial to explore how the integration of religious sciences and science can be transdisciplinary to provide a more holistic understanding for students (Rizal, 2018)

In the context of Islamic Religious Education (*Pendidikan Agama Islam, PAI*), the need to connect Islamic teachings with empirical realities has become increasingly urgent, given the global challenges that require religious understanding that is rational, open, and capable of engaging in dialogue with other disciplines. The transdisciplinary approach emerges as one epistemological and pedagogical solution that bridges the gap between religious sciences and science, as it not only combines two disciplines but also builds a new framework of knowledge that transcends traditional academic boundaries.

The integration of science and religion is grounded in ontological, epistemological, and axiological bases. Ontologically, it recognizes a unified reality where God is the ultimate source of all knowledge. Epistemologically, it acknowledges that both scientific and religious knowledge stem from divine revelation, utilizing reason, senses, and intuition as tools for understanding. Axiologically, it emphasizes that science should not be value-free but aligned with moral and spiritual values, promoting benefits for both worldly and spiritual life (Abdullah, 2014; Rahma et al., 2024).

Various pedagogical approaches are employed to integrate religious and scientific knowledge. These include the equality approach, which treats both domains as equally important; the parallelization approach, which runs them alongside each other; and the complementary approach, which sees them as mutually reinforcing. These methods aim to eliminate the dichotomy between science and religion, fostering a holistic educational experience (Jaeni & Kusumawati, 2025).

In Islamic education, the integration of science and religion has significant implications for curriculum development, teaching methods, and student outcomes. It encourages a curriculum that harmonizes religious values with scientific knowledge, fostering critical and reflective thinking among students. This integration also supports the development of a comprehensive worldview that respects religious diversity and promotes ethical behavior (Mahmudi et al., 2022; Sundari & Nasution, 2024).

Despite its potential benefits, the integration of religious sciences and science faces challenges such as the persistence of knowledge dichotomy, weak curricula, and technological limitations. Addressing these challenges requires strengthening human resources, developing integrated curricula, and implementing interdisciplinary policies. These efforts can enhance the

educational experience and prepare students for a world where science and religion coexist harmoniously (Sholehah, 2025).

The literature shows that the transdisciplinary theory (Nicolescu, 2002) emphasizes dialogue between various levels of reality and logic to generate new knowledge, while the integrative-interconnected paradigm (Yulanda, 2019) highlights the importance of epistemological dialogue between religious sciences and science. Previous studies, M. Iqbal Lubis, Ilyas Husti, (2023) at UIN Sunan Kalijaga and Lubis, Helmiati, and Nazir (2025) at UIN Malang have revealed that knowledge integration has great potential, but its implementation requires readiness from lecturers, curricula, and academic culture. However, despite efforts to integrate these two fields, there remains a gap in the literature discussing how this transdisciplinary approach is applied in the Islamic religious education curriculum, particularly in Indonesian Islamic Higher Education (PTKIs). Existing studies mostly focus on theoretical aspects or studies outside the context of Islamic education in Indonesia. Research on the practical application of the transdisciplinary approach in PAI learning remains limited, making this study crucial to fill that gap. This gap drives this research to further explore the implementation of a transdisciplinary approach in Islamic education at UIN Sumatera Utara. This study aims to assess how the integration of religious sciences and science can be implemented in the teaching process of Islamic Religious Education (PAI) and its impact on character building and students' critical thinking skills (Fatima et al., 2017)

At UIN Sumatera Utara, efforts to implement knowledge integration through a transdisciplinary approach have been positioned as part of the institutional transformation from IAIN to UIN. However, its application at the classroom level, particularly in PAI courses, still requires empirical investigation into how this integration process takes place in practice. Preliminary observations show that lecturers attempt to link religious material with social, scientific, and technological phenomena, but it remains unclear how students respond, how the dynamics of the learning process unfold, and to what extent the transdisciplinary approach produces epistemological and pedagogical impacts on PAI learning. Therefore, this research is crucial for exploring the direct practice of knowledge integration through field studies, providing a comprehensive picture of the effectiveness of the transdisciplinary approach in Islamic education.

At UIN Sumatera Utara, lecturers have attempted to link religious material with social, scientific, and technological phenomena. However, it remains unclear how students respond to these efforts, how the dynamics of the learning process unfold, and to what extent the transdisciplinary approach produces epistemological and pedagogical impacts in PAI learning. The gap in existing research, particularly in the practical application of a transdisciplinary approach in PAI at UIN Sumatera Utara, creates a need for this study. By conducting field studies and observing these integration practices, this research aims to provide a comprehensive picture of the effectiveness of the transdisciplinary approach in Islamic education.

The novelty of this research lies in its focus on the empirical implementation of the transdisciplinary approach in PAI learning, specifically at UIN Sumatera Utara. This study integrates observational analysis, connects empirical findings with two main theories, and provides an initial model of knowledge integration in PAI learning. The results of this study have the potential to generate a new conceptual model of how the integration of religious sciences and science can be applied in PAI learning through analytical, dialogical, and contextual activities that can be replicated at other Islamic higher education institutions.

Using a qualitative approach with a field study method, this research not only provides insights into the effectiveness of integrating religious sciences and science but also offers a new contribution to developing a curriculum for Islamic education that is adaptive to the times. This study is expected to serve as an important reference in formulating a more relevant and comprehensive Islamic education model that combines religious values with scientific advancements and technology in the digital era.

## Methods

This study employs a qualitative approach with a field research design (Creswell, 2014), aiming to deeply understand how the integration of religious sciences and science is applied in Islamic Religious Education (PAI) learning through a transdisciplinary approach at UIN Sumatera Utara. Informants were selected using purposive sampling, with primary data collected through direct classroom observations, in-depth interviews with PAI lecturers, students, and curriculum managers, while secondary data was obtained from books, scholarly journals, curriculum documents, RPS, and relevant institutional publications (Miles, 1994).

Data collection techniques included observation, structured interviews, and document analysis to provide a comprehensive understanding of pedagogical strategies, learning interactions, and forms of knowledge integration (Bowen, 2009; Seidman, 2006; Spradley, 1980). Data analysis was conducted using the Miles and Huberman model (1994), involving data reduction, data presentation, and continuous drawing of conclusions. The validity of the findings was ensured through source and method triangulation, member checking, and peer debriefing (Denzin, 2017; Guba & Lincoln, 1982). This research is supported by transdisciplinary theory of Nicolescu (2002), the integrative-interconnected paradigm of Abdullah (2006) and Piaget (2008), as well as a constructivist perspective that emphasizes the formation of knowledge through interaction and social context, providing a strong foundation for understanding the process of knowledge integration in PAI learning.

## Results and Discussion

*Forms of Transdisciplinary Approach Implementation in Islamic Education Learning*

Based on observations of several Islamic education lectures at UIN North Sumatra, it appears that lecturers have begun to integrate scientific concepts with religious material more explicitly. This integration is not only in the form of inserting scientific knowledge into religious explanations, but is also evident in learning strategies, the use of digital media, and academic assignments that require students to conduct interdisciplinary studies. This learning pattern shows a conscious effort on the part of lecturers to present PAI learning that is relevant to the development of science while remaining rooted in Islamic scientific tradition.

In one of the courses observed, namely Tafsir (Interpretation of the Qur'an) learning, the integration between religious knowledge and science was very clear and structured. Based on the results of the observation, lecturers no longer teach tafsir only through the conventional reading of classical books, but combine it with the use of digital technology and contemporary scientific studies. In the learning process, students are guided to explore various tafsir literature through *Maktabah Syamilah*, a digital literacy platform that contains thousands of works by classical scholars. The use of digital media not only facilitates access to literature but also trains students to adapt to

technological developments as part of modern academic skills. Based on an interview with one of the lecturers teaching the Tafsir course, this integration was deliberately designed to foster a transdisciplinary mindset. The lecturer stated that:

*"Students should not just read classical tafsir and stop there. They must be able to connect the verses of the Qur'an with evolving scientific realities. Therefore, I always ask them to read scientific journals and prove the relevance of verses through credible scientific studies."*

This quote reinforces the observation that the Tafsir learning process has shifted from a traditional pattern to a more comprehensive and dialogical learning model, involving scientific data, research, and digital literacy as part of religious analysis.

In addition to Tafsir learning, one form of transdisciplinary approach implementation that is increasingly evident in the academic environment of UIN North Sumatra is the Transdisciplinary Islamic Studies Approach course in the Islamic Education (PAI) Master's Program. Based on the results of observations and interviews, this course is specifically designed to introduce students to a model of Islamic studies that does not rely on a single perspective, but combines various disciplines such as sociology, economics, psychology, and modern science in understanding religious phenomena. Through this course, students are introduced to a transdisciplinary framework that positions Islam as a religion and a source of values that can engage in dialogue with contemporary scientific developments. The presence of this course is proof that the integration of knowledge at UIN North Sumatra does not only occur in the methodological realm in certain classes, but has also been formally institutionalized in the curriculum structure. One of the lecturers teaching this course explained that:

*"Islamic Education students must be equipped with a broader way of thinking. A transdisciplinary approach is important so that they understand that religion does not stand alone, but interacts with culture, science, and the developments of the times."*

This explanation shows that the learning orientation at the master's level no longer focuses solely on mastering religious material, but also on forming a scientific perspective that is able to link religious insights with social dynamics and scientific developments. Based on the results of follow-up interviews, the lecturer emphasized that the main objective of this course is to produce graduates who are able to integrate Islamic values in various scientific contexts and modern social issues. Thus, the transdisciplinary approach is not only interpreted as a method of study, but also as a foundation of thinking that students must possess in order to respond to educational, social, and religious issues more comprehensively.

The results of this study are in line with the idea of integration-interconnection in Islamic studies developed by Amin Abdullah (2006) and reinforced by several recent studies, such as a study by Harni and Amaluddin (2025) which shows that the integration of religious and scientific knowledge in PAI learning can improve students' analytical thinking skills and foster a more contextual understanding of religion. This is in line with the findings of observations on Tafsir learning at UIN North Sumatra, which combines classical studies, digital literacy, and modern scientific references. In addition, the learning approach at UIN North Sumatra is in line with the transdisciplinary theory proposed by Basarab Nicolescu (2002), which views that solving modern human problems requires cross-disciplinary collaboration, even beyond the boundaries of traditional disciplines. The use of scientific data, digital technology, and social analysis in PAI learning shows that the learning process has gone beyond monodisciplinary and multidisciplinary approaches.

*The Role of the Academic Environment at UIN North Sumatra in Supporting Integration*

Based on observations of the academic environment at UIN North Sumatra, it appears that the campus academic culture has provided considerable space for the development of the integration of religious and scientific knowledge. This integration is evident not only in the form of curriculum policies, but also in academic activities, research culture, and the learning atmosphere that encourages students and lecturers to link religious values with modern scientific approaches.

The results of the observation show that academic facilities such as digital libraries, access to international journals, computer laboratories, and the use of e-learning platforms have been utilized to support transdisciplinary learning. In several courses, students are directed to search for scientific literature through online journal portals and campus repositories as part of the process of analyzing religious texts. This condition shows that the academic environment at UIN North Sumatra strives to provide a learning ecosystem that is adaptive to the development of science.

These observations were reinforced through interviews with one of the faculty's academic officials, who explained that the integration of knowledge is indeed part of the institution's vision. He stated that:

"*Currently, we are promoting the Wahdatul Ulum paradigm, so that each study program is directed to link Islamic scholarship with scientific developments. Our academic environment strives to ensure this through the curriculum, research culture, and other academic activities*."

This statement is in line with the researcher's observations of various scientific forums that are regularly held on campus, such as national seminars, research methodology workshops, public lectures, and lecturer-student discussions. These activities substantively present many interdisciplinary themes, such as the integration of the Qur'an and science, technology-based Islamic education, and a social-humanities approach to Islamic studies. The presence of these forums reflects that the campus academic environment actively supports the formation of an integrative intellectual tradition.

In addition, based on interviews with several students, the integration of knowledge is also supported through the implementation of research-based assignments that require students to cite scientific journals, conduct field observations, and connect religious theory with social phenomena. One student mentioned that:

"*In some courses, we are asked not only to read classical texts, but also to search for the latest data from national and international journals. Lecturers emphasize that understanding religion must be linked to current realities*."

This statement shows that there is academic awareness at the student level that studying religion at UIN SU is not just about understanding texts, but also analyzing context through a scientific approach. An academic environment that emphasizes digital literacy, research culture, and interdisciplinary thematic discussions further strengthens the integration between religious studies and science.

Based on the overall results of observations and interviews, it can be concluded that the academic environment at UIN North Sumatra has proven to play an important role in supporting the integration of religious studies and science. This can be seen from the adequate academic facilities, transdisciplinary-oriented curriculum, and a growing research culture. Academic interactions that encourage the strengthening of scientific literacy and the linking of religious texts to the current context show that integration is not only a discourse but has been implemented in learning practices. Thus, this academic ecosystem becomes the foundation for the realization of PAI learning that is more relevant and adaptive to the development of modern science.

The *Wahdatul Ulum* paradigm views religious knowledge and modern science as an inseparable unity. Revelation is the source of values and morals, while empirical science serves to understand social and natural realities rationally. This integration requires a dialogue between religious texts and scientific findings, so that the educational process encourages a contextual, adaptive, and transdisciplinary understanding of Islam. This theory is relevant to the academic conditions at UIN North Sumatra, which integrates curriculum, research culture, and academic activities based on the interconnection of religious and scientific knowledge (Ritonga, 2022).

Peter Drucker (2001) states that modern society is moving towards a *knowledge society*, which is a society that places knowledge as the main source of productivity, progress, and innovation. Higher education must build an ecosystem that encourages digital literacy, research, scientific collaboration, and the ability to critically access, process, and apply scientific information. This theory supports the research findings that the academic environment at UIN North Sumatra has utilized digital technology, access to scientific journals, and research-based learning to strengthen the integration of science and improve the intellectual capacity of students as part of a knowledge-based society.

*Student Responses and Perceptions*

Based on observations in several Islamic Education (PAI) classes at UIN North Sumatra, it appears that students show considerable enthusiasm for the application of the integration of religious and scientific knowledge through a transdisciplinary approach. During the learning process, students appear to actively discuss, ask questions, and attempt to relate religious material to relevant scientific concepts.

Learning activities were no longer one-way, but developed into interactive dialogues between lecturers and students. Lecturers not only conveyed religious theories, but also linked them to social phenomena, nature, and technological developments. The observations also showed that students were more motivated to understand the meaning of Quranic verses scientifically and contextually. For example, when discussing *kauniyah* verses, students were invited to analyze them using natural science approaches, such as physics and biology. Thus, learning became more meaningful because students could see the relationship between revelation and empirical reality.

Based on interviews with several informants, it was found that they generally had a positive perception of this transdisciplinary approach. Most informants stated that the integration of religious knowledge and science made them understand Islamic teachings more rationally and relevant to modern life. One informant said that "Islamic education learning has become more lively because we don't just learn verses and hadiths, but also see how those verses can be linked to scientific theories that are real in life." Another informant said, "At first, I was confused about how to connect religious knowledge and science, but after the lecturer explained it with concrete examples, it turned out that the two support each other." Several informants also assessed that this approach helped them to think more openly, as expressed by one informant who said, "this way, we understand that Islam strongly supports science, and that learning science can also be a form of worship." Overall, the interview results show that the transdisciplinary approach is able to build positive perceptions of Islamic Religious Education among students, broaden their perspective on the relationship between religion and science, and foster a more reflective and integrative spirit of learning.

The application of a transdisciplinary approach in Islamic Religious Education (PAI) at UIN North Sumatra has had a positive impact on students' enthusiasm, motivation, and way of thinking.

The findings of the observation show that students are no longer passive recipients of information but are actively involved in a dialogical and reflective learning process. They appear eager to link religious concepts with scientific theories, indicating that this approach has succeeded in encouraging meaningful and contextual learning (Adiyono et al., 2024).

The shift from one-way learning to two-way interaction between lecturers and students enriches the learning experience. Lecturers act not only as conveyors of religious teachings, but also as facilitators who help students find the relevance between revelation and empirical reality. For example, when discussing *kauniyah* verses, students do not merely understand their meaning textually, but are also invited to interpret them through scientific perspectives such as physics, biology, and natural sciences.

This kind of integration demonstrates the synergy between religious and scientific knowledge, which strengthens faith while broadening students' rational insights (Hajita, 2024). The interview results reinforce the findings of the observation by showing that students have a positive perception of the transdisciplinary approach.

They feel that the integration of religious and scientific knowledge makes PAI learning more relevant to the times, while also helping them to understand Islam rationally. Several informants revealed that this approach makes learning more "lively" because the verses of the Qur'an are not only understood normatively, but also linked to real social and scientific phenomena. This integrative approach is consistent with the literature on the integration of science and religion in Islamic education, which emphasizes the importance of holistic and contextual learning models to build a rational and contextual understanding of religion (Mahanis & Bakar, 2025; Mahyarni & Alpizar, 2024).

In addition, the transdisciplinary approach helps students think more openly and critically. They begin to understand that Islam is not a teaching that is separate from science, but rather a religion that supports the search for and development of knowledge. This awareness fosters the attitude that studying science is also part of worship and a form of appreciation of Islamic values. Thus, this approach not only enriches students' cognitive aspects but also shapes a balanced spiritual and intellectual attitude (Handayani, 2025; Jalil & Bakar, 2025).

Overall, the results of this study indicate that a transdisciplinary approach in PAI learning is effective in building integration between faith and knowledge, as well as improving the quality of the learning process. Students become more active, critical, and have higher motivation to learn. This integration also has the potential to give birth to a new paradigm in Islamic education, namely education that emphasizes a balance between religiosity and rationality, and makes science a means to understand God's greatness more deeply (Mahmudi et al., 2022; Siregar & Hasibuan, 2025).

*The Impact of the Transdisciplinary Approach on the Learning Process*

Based on field observations, the application of the transdisciplinary approach in Islamic Religious Education (PAI) at UIN North Sumatra has had a tangible impact on the dynamics of the learning process in the classroom.

The learning atmosphere appears to be more active, participatory, and interactive compared to conventional methods. Students not only listen to the lecturer's explanations but also engage in discussions, case analyses, and collaborative activities that link religious concepts with scientific and social phenomena. Lecturers act as facilitators who encourage students to think critically and seek connections between Islamic values and modern scientific theories. On several occasions, students are invited to examine verses from the Qur'an related to science, such as the creation of

the universe, the environment, or health, and then compare them with scientific research results. Observations show that this approach increases students' motivation to learn, makes them more focused, and fosters enthusiasm to explore the relationship between religious knowledge and science in greater depth.

Based on interviews with several informants, it is known that the transdisciplinary approach has a positive influence on students' thinking and understanding in learning. Informants said that learning became more challenging because they had to understand the material from both a religious and scientific perspective. One informant revealed, "*Learning becomes more challenging because we have to understand the material from both a religious and scientific perspective. But from that, I have become more critical and do not quickly accept information without reviewing it from both sides."* Another informant added that *"this approach makes students more courageous in expressing their opinions and thinking openly. They are beginning to get used to seeing the relationship between religious arguments and scientific theories."* In addition, one informant also admitted that this approach strengthened their spiritual awareness, *"we became aware that learning science is also part of understanding the greatness of Allah, so the knowledge feels more meaningful."* Thus, the interview results show that the transdisciplinary approach not only improves the quality of the learning process but also shapes the character of students who think scientifically while being based on Islamic spiritual values.

Application The application of a transdisciplinary approach in Islamic Religious Education (PAI) at UIN North Sumatra has had a significant impact on the dynamics and quality of the student learning process. This approach encourages a transformation of the learning atmosphere from a conventional one, where students tend to passively receive material, to a more active, participatory, and interactive one.

During the learning process, students not only listen to explanations from lecturers but also engage in various collaborative activities such as discussions, case analyses, and reflections on social and scientific phenomena related to Islamic teachings. Lecturers act as facilitators and mediators of knowledge, not merely as conveyors of material.

This is in line with the main principle of transdisciplinary learning, which places students as active subjects in the process of knowledge construction (Fortuin & Van Koppen, 2016; Hoffmann et al., 2022; Horn et al., 2023). Students are encouraged to think critically and reflectively in seeking connections between Islamic values and modern scientific theory, so that learning becomes more meaningful and contextual.

One concrete application of this approach can be seen when students study verses from the Qur'an related to science, such as those concerning the creation of the universe, the environment, and health. Students then compare and relate the meaning of these verses to the latest scientific research, thereby integrating revelation and reason. This activity not only deepens their understanding of the verses on nature but also fosters awareness that science is one of the ways humans can recognize the greatness of God.

Observations show that learning in this way can increase students' motivation to learn, focus, and curiosity to continue exploring the relationship between religion and science. The interview results support these observations. The informants stated that the transdisciplinary approach provided new intellectual challenges because they had to understand the material from two perspectives at once, religion and science.

Although challenging, this trains students to think more critically, analytically, and not to accept information unilaterally. One informant said that learning became more challenging but also more meaningful because it required a dual understanding of revelation and scientific theory.

Another informant added that this approach fostered the courage to express opinions and broadened their perspective on the relationship between religious arguments and empirical knowledge.

Furthermore, the transdisciplinary approach also has an impact on strengthening the spiritual dimension of students. Through the integration of religious and scientific knowledge, students began to realize that studying science is not separate from Islamic values, but rather part of worship and appreciation of the signs of God's greatness. As stated by one informant, learning science through an Islamic perspective makes science feel more meaningful and spiritually valuable.

Thus, this approach not only improves students' cognitive aspects but also shapes their character to think scientifically while being grounded in Islamic spiritual values. Overall, the application of a transdisciplinary approach in PAI learning has proven to improve the quality of the learning process, strengthen student motivation and participation, and create a balance between rationality and spirituality. The integration of religion and science opens up space for students to understand Islam contextually and scientifically, while strengthening the relevance of Islamic teachings in facing the challenges of modern life. Thus, the transdisciplinary approach can be an effective alternative learning model in realizing holistic and integrative Islamic education (Adyaksa & Sudirman, 2024).

The study revealed significant insights into the implementation of a transdisciplinary approach in PAI (Islamic Religious Education) at UIN Sumatera Utara. The integration of religious sciences with contemporary scientific knowledge was more than just an academic pursuit, it represented a cultural and epistemological shift towards a more holistic educational framework. The integration manifested not only in the curriculum and teaching methodologies but also in the way students engaged with the material. The findings indicate that students actively participated in discussions that bridged the gap between faith and science, especially in courses like Tafsir, where traditional methods were complemented with digital literacy and scientific perspectives. The use of platforms like Maktabah Syamilah for literature exploration further encouraged students to engage with Islamic texts in ways that align with modern intellectual developments.

In another notable example, the course Transdisciplinary Approach to Islamic Studies aimed to broaden students' understanding by integrating multiple disciplines. This curriculum reformation aligns with Abdullah's (2006) theory of integrative-interconnected knowledge and Nicolescu's (2010) transdisciplinary theory, which advocates for a dialogue across various disciplines to create new, comprehensive knowledge.

While the findings were promising, several limitations need to be addressed. For one, this study primarily focused on one institution, UIN Sumatera Utara, meaning that the results may not be directly applicable to other institutions with different academic cultures. Moreover, despite the evident engagement of students with transdisciplinary content, the research did not sufficiently capture long-term impacts on students' intellectual development or career trajectories. This aspect, particularly the effects of transdisciplinary learning on professional practice, remains underexplored and warrants further investigation.

One of the key limitations of this study was the reliance on purposive sampling, which, while useful for focusing on specific groups, limits the ability to generalize the findings to broader populations. Moreover, the observational data gathered in the classroom were not longitudinal, meaning that the impact of the transdisciplinary approach over a longer period is still unknown. Future research could benefit from a more longitudinal study design to track the long-term effects

of this pedagogical approach on students' cognitive and professional development. Further, a broader sample from multiple universities would enhance the external validity of the findings, allowing for comparisons between institutions with varying degrees of institutional commitment to transdisciplinary education.

Another challenge was the limited exploration of the challenges faced by lecturers in implementing a transdisciplinary approach. While the study captured the positive outcomes of integration, it did not fully address the institutional barriers or personal challenges that lecturers may have encountered in adopting such an approach. Future studies should include interviews with a broader range of academic staff to understand their perspectives on the difficulties of integrating religious sciences with modern disciplines.

Given the evolving nature of education in the 21st century, future research should delve deeper into the impacts of transdisciplinary learning beyond the classroom. The potential of transdisciplinary education to foster students' problem-solving skills, critical thinking, and adaptability in various professional contexts remains an area ripe for exploration. Additionally, research should also investigate how other universities in Indonesia and beyond approach the integration of religion and science, comparing the effectiveness of various models and strategies.

Moreover, it would be valuable to explore how students' religious identity evolves in a transdisciplinary learning environment. Does the integration of science and religion influence students' faith, or does it reinforce their existing beliefs? Further studies could also consider the role of digital tools and online learning platforms in facilitating this integration. While the study at UIN Sumatera Utara highlighted the use of digital platforms like Maktabah Syamilah, future studies should explore the broader role of digital literacy in fostering a transdisciplinary mindset.

In terms of pedagogy, future research should focus on developing and testing specific instructional strategies that encourage students to engage with both religious and scientific material in a way that is both intellectually rigorous and spiritually enriching. How can educators balance the demands of modern scientific rigor with the need to maintain religious authenticity? This question remains a central issue in the integration of religious studies with other disciplines.

This study has contributed to the ongoing conversation about the integration of religious sciences and modern disciplines, demonstrating how the transdisciplinary approach can enhance the learning experience. By drawing on established theories like those of Nicolescu and Abdullah, the research offers a conceptual framework for future studies to explore this integration in greater depth. However, it is clear that there are still significant gaps in our understanding of how transdisciplinary approaches impact both the personal and professional development of students. The study calls for further research that addresses these gaps and explores the long-term effects of such integrative educational practices.

The findings of this research highlight that while transdisciplinary education offers great promise for creating a more comprehensive and holistic educational experience, its successful implementation requires continuous reflection, institutional support, and a willingness to adapt to the changing demands of both science and society.

## Conclusion

This study demonstrates that the application of a transdisciplinary approach in Islamic Religious Education (PAI) learning at UIN Sumatera Utara creates a more comprehensive integration between religious sciences and science. This approach not only merges the two disciplines but also

contributes to shaping the critical thinking of students, enabling them to connect religious teachings with contemporary scientific phenomena. The transdisciplinary concepts applied in courses such as Tafsir and Transdisciplinary Approach to Islamic Studies show significant potential in enriching students' understanding, encouraging them to not only rely on classical knowledge but also explore contemporary scientific fields.

However, this study has limitations in terms of generalizing the findings, as it focuses on a single educational institution in Indonesia. Further research should involve a broader sample from various universities and Islamic educational institutions to assess whether these findings can be applied more widely. Additionally, this research has not fully explored the challenges faced by lecturers in implementing this approach, which is an important aspect in evaluating the practical application of transdisciplinary education.

From a policy perspective, the findings suggest the importance of a more structured curriculum integration at the higher education level to align religious education with modern science. Therefore, policies that support the development of digital skills and scientific literacy among lecturers and students need to be strengthened. Educational practices involving digital technology and scientific research should be more widely adopted to engage students in learning processes relevant to current developments. This research contributes to the development of a more holistic and transdisciplinary model of Islamic education, which can serve as a reference for future education policy formulation.

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