

The practice of science and religion integration: Evidence from an Indonesian Islamic school

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Abstract: This paper answers the call for the importance of integrating the Islamic worldview into science classes. This research provides insights into science teachers' experiences of integrating science and Islam, as well as additional surveys to reveal gains in student understanding. This research consists of two stages. Study 1 used phenomenology and focused on the voice of science teachers through focus groups. This research involved five focus groups in five Islamic high schools providing information describing their experiences. Through thematic analysis techniques, several findings were obtained as follows: (1) the concept of integration emphasises more on the balance of compliance between vertical and horizontal; (2) the integration pattern places more emphasis on learning materials; and (3) in terms of benefits, this effort is focused on increasing understanding and followed by study 2 which aims to add to the evidence base by investigating the effect of integration patterns on student understanding. The results showed that there is evidence that the support of an overarching integration pattern contributes to students' understanding of the material. As a recommendation, it is necessary to strengthen integration at all stages of science learning, allowing students to take advantage of discussions in class to develop more relevant abilities.

Keywords: integration learning; Islamic worldview; science education; science teacher perspective; student comprehension

Introduction

Science education is described as a critical practice area taught at various levels of education worldwide (Sozbilir *et al.*, 2012; Taber, 2015). However, some scholars have warned that science has the potential to come into conflict with religion. Leicht *et al.* (2022) and Akkari and Radhouane (2022) explained that it is difficult for students to integrate science and religion as knowledge, and the impact is that science wins over religion and vice versa. Meanwhile, Peters (2017) and Chan and Erduran, (2023) expressed

his opinion that science and religion interacted at many intersections and concluded that simple things could mislead students.

Seeing this potential, Islamic schools like in Indonesia, which teach science and Islam simultaneously, have a great interest in resolving this tension (Daulay & Tobroni, 2017). Few scientific scholars who have mastered science and technology find it difficult to integrate into Islamic science and don't even feel its connection with the Islamic world (Avraamidou, 2020; Malik, 2023). In contrast, many Muslim scholars who master religious knowledge are unable to use their knowledge to solve contemporary problems that are currently being faced by society (Abedin et al., 2021; Suleymanova, 2020; Zaini & Syafaruddin, 2020).

Much effort has been made to reform Islamic education in Indonesia by balancing science with Islamic knowledge. This method integrates the Islamic worldview into science learning (Azra, 2018; Husamah et al., 2022; Suyadi et al., 2022). Roth (2010) and Edis (2023) explained that the differences experienced by students regarding the relationship between religion and science only required dialogue in class to arrive at solutions for the common good. Science and religion are said to have the same characteristics. For example, try to answer the question of who we are and where we, the world, and the universe come from (Trevors & Saier, 2010). Islam is said to be able to complement science by providing important guidelines and frameworks for students in their pursuit of curiosity and knowledge (Alassiri, 2020; Dajani, 2022).

Although there is no official data on how many science teachers are trained in religious disciplines, science is adequately reflected in the Islamic religious education curriculum (Wakhidah & Erman, 2022). Religious activities are part of education, and religion is a mandatory aspect of the national curriculum (Sujarwoto et al., 2021; Utami, 2022). The strength of this curriculum can be utilised for integration efforts in Islamic schools. The choice to focus on Islamic high schools in Indonesia is not coincidental: besides being the country with the largest Muslim community in the world (Hefner, 2020; Lukens-Bull & Woodward, 2020) and also has many Islamic-based schools with various styles, teenage students in Indonesia also have high level of religiosity (Ridwan & Diantimala, 2021).

According to the teachers, the first research question (RQ1), what is the role of integrating Islamic worldview in science class? This is the main overarching question that this research seeks to answer. This raises the following sub-questions: (1) What is the science teacher's understanding of integrating the Islamic worldview and science? (2) How is the integration pattern of Islamic worldview in science class? And (3) What are the benefits of integrating Islamic worldview and science for student learning outcomes? This research question is open-ended, allowing teachers to provide various and unexpected answers and are free to give direct statements to the interview questions given (Hyman & Sierra, 2016) so there is a diversity of points. To answer this question, this study uses data from focus group discussions (FGD) with science teachers ideologically collected between 2021 and 2022.

In the era of Science-engaged Theology (SET), this research may provide a new interface being developed: the perspective of science teachers on the role of integration of the Islamic worldview and science, which discusses teachers' understanding and experience of "concepts," "patterns," and "benefits." On an international scale, the John Templeton Foundation has funded projects related to science and religion to a number of universities for this purpose in 2020 (Page, 2023). Of course, we realise that various typologies of connecting science and religion have hindered efforts to explore this, especially in Indonesia. Moreover, to our knowledge, only a few studies have evaluated the effects of integrating science and Islam (De Cruz, 2022; Fahyuni et al., 2020; Purwati et al., 2018) and limited to students perception (Suciati, Susilo, et al., 2022). However, some available research has not reviewed the level of integration or teaching patterns on learning outcomes as benefits. Based on this shortfall, we are continuing additional surveys to fill the gap. The second research question (RQ2), do students who are taught with an integrated pattern all have higher learning outcomes scores than students who are taught with an integrated pattern of only learning material?

In summary, we expect that highly qualified teachers pursuing a holistic integration pattern will support students in improving their learning outcomes and skills (Ningsih et al., 2022; Suciati, Gofur, et al., 2022; Wulan et al., 2021). Furthermore, this effort will provide an instructional context that helps students develop religious attitudes and other relevant skills (Alam & Rachmadhani, 2021; Fahyuni et al., 2020; Suciati, Gofur, et al., 2022). In other words, the impact of teacher teaching methods on student learning outcomes is multidimensional (Hill & Chin, 2018; König et al., 2021). Just as this study also focuses on comprehension, previous research has revealed a sizable difference between teachers who integrate Islamic values and those who do not (Purwati et al., 2018). However, the results of this study further highlight the impact of the overall integration pattern and only on learning materials on student understanding.

We believe that without explicit attention to Biology teachers' views regarding the integration of science and Islam in Islamic schools, the educational goal of creating students as whole human beings will be difficult to achieve. To do this, in research I we reviewed the arguments given by Biology teachers to justify why it is important to integrate Islamic values in science learning. Then, in study II, based on the conclusions we reached in study I, we considered comparing students' learning outcomes from various

intergration patterns and showing how the integration patterns chosen by teachers can promote higher student learning outcomes in biology.

Method

Study 1

Research Design

This research approach used a phenomenology design. This methodology was applied by considering various things. First, this study aims to capture the meaning of efforts to integrate the Islamic worldview into science classes in the context of Islamic senior high schools in Indonesia from the teachers' perspective. Second, this study aims to explore the understanding and essence of teachers' experiences regarding how they carry out this integration.

Thus, the phenomenological methodology provides an advantage to researchers because it can obtain information about the efforts and actions taken by the teacher openly rather than perceptions that were formed long before that (Neubauer et al., 2019). This method can maintain openness to discoveries and provides a structured framework for data collection and analysis (Klinke & Fernandez, 2022). Based on the recordings and transcripts obtained during data collection, we created themes and categories that helped us understand the role of integration of the Islamic worldview in science classes in a given time frame and place.

School site

The participants selected in this study were biology teachers who teach at five Islamic high schools in Ternate, Indonesia. Each school has three to four biology teachers, so seventeen (17) science teachers are involved. Of the five schools, three private schools (three teachers each) and two public schools (four teachers each). We aimed to recruit teachers for five (5) homogeneous natural science discipline-specific focus groups of teachers with two different academic ranks (teachers with bachelor's and master's academic degrees). Of these science teachers, about three-quarters are women, with an average length of teaching experience of around seven years. In addition, about a quarter of Ternate's science teachers have a master's degree.

Although focus groups require a large sample, this is impossible because the number of teachers who have experience integrating Islamic worldviews into science classes is limited. In other words, this study uses mini-expert groups because there are only 3-4 teachers per group (Eeuwijk & Angehrn, 2017). Focus group methodologies pose different ethical challenges. Confidentiality and anonymity can pose problems (Sim & Waterfield, 2019). Focus group methodologies pose other ethical challenges. Privacy and anonymity have the potential to pose problems.

Data collection

Data was collected from selected schools between July 2021 and March 2022. The lead researcher sent a letter of application to the principal via email. Based on the results of these answers, we followed up with five schools with direct visits. This meeting was held to discuss the research to be carried out and to increase trust between the researcher and the school. This meeting resulted in a recommendation to gather all Biology teachers in every school.

Before data collection, we held an initial meeting with the teachers to explain the purpose of the research, why it was carried out at the school, what benefits were obtained, and how this research would be carried out. At the end of this meeting, we provided an informed consent sheet. Before the participants gave their consent, we explained that their participation was voluntary, so they could withdraw from the research process at any time. The identities and data of the participants are also kept confidential and only accessed by researchers, who are then analysed and shared in scientific publications. For anonymity, each teacher is only labelled in order, namely G1, G2, G3, and so on up to G17.

After obtaining ethical approval at the initial meeting, we followed up with FGD activities the following day. FGD was chosen as an appropriate phenomenological technique to collect qualitative data (Albanesi, 2014). Researchers allocated 60 minutes for each focus group. The data extracted during the FGD focused on three research questions regarding the concept, implementation, and benefits of integrating the Islamic worldview into science class.

Organising, analysing, and synthesising data

Broadly speaking, this study used the thematic content analysis method adapted from Creswell (2012). This step involves two main stages. First, the data was transcribed and repeatedly read by the two primary investigators. In the reading process, we engaged in the 'bracketing' process, where the researcher inserts knowledge and beliefs that are considered essential to explain the phenomena conveyed by the participants (Eddles-Hirsch, 2015). Second, the researcher looks for themes in each

statement submitted by the participants. This step involves the horizontal phenomenological data reduction process. Participant statements for each research question were cut and pasted into separate tables. This is done so that the participant's opinion remains intact and does not change (Swain et al., 2018). From this step, we collected the core themes from the statements of all participants to obtain a composite text that represents the phenomenon under study.

Study 2 Participants

Around 179 students from five K-12 Islam in Ternate, North Maluku Province, were willing to participate in this second study. The age range of students participating is approximately 15-18 years old, and more than half are girls. This sample comprises 60 grade 10 students, 55 grade 11 students, and 64 grade 12 students. More details can be seen in Table 1. This analysis uses survey data to explore the effect of certain integration pattern practices on student achievement, namely understanding student science.

Table 1. The Number of Participants in the Student Understanding Survey based on the Interrogation Patterns Studied

Class	Outline the overall integration pattern (Pattern A)	The taught pattern of integration of learning materials only (Pattern B)
10	30	30
11	27	28
12	32	32

Data collection process

Teacher instructional behaviour in Islamic integrated science classes is the central research theme for this follow-up study. Based on the teaching patterns carried out by the science teachers who were involved in the first study, the assessors grouped them into two large groups, namely (1) teachers with a particular integration pattern starting from objectives, steps, materials, and learning evaluation, and (2) teachers with a pattern integration that applies integration patterns only to learning materials. After grouping, we asked the teacher to collect their respective students to be surveyed. At this meeting, we explain the research steps that will be carried out and the benefits that will be obtained from the results of this research. Most of the teachers agreed to help with this second research process. Next, the teacher provides a knowledge survey link to students via email and is asked to answer by sending a handwritten answer file. Of the 250 students requested, only 179 students returned. Thus, the response rate of this survey is only 71.6%.

Instruments

This research provides a cognitive test for a student understanding survey given to students in the last week of the semester. All participating students must complete six essay questions within the allotted time of 90 minutes. Thus the maximum score that can be obtained is 60. Regarding the questionnaire design, the items are stated in the same way: given phenomena and verses of the Qur'an, students are asked to explain the meaning of these phenomena and verses. The only difference between grade 10, 11, and 12 tests is the content tested refers to the learning material. Examples of topics and verses of the Koran given as tests of knowledge in more detail can be seen in Table 2. Each instrument used in this study was confirmed for its validity and reliability. Before use, this test instrument was provided to the expert to ascertain advanced and content validity. After being declared valid, the instrument was tested and analysed. The validity measurements using the Pearson correlation show that all item items are valid with a p-value of less than 0.05 and reliability with a Cronbach's alpha coefficient greater than 0.75.

Table 2. Sample Topics and Verses Used in the Test Instrument

Class	Theme	Topics	Qur'an verses
10	Environment	Food chain Hydrology	As-Sajadah: (32:27) Al-A'Raaf: (7:57)
11	Human physiology and anatomy	Pregnancy process Disease and healing Biotechnology concept	Hud: (11:71-73) At-Taubah: (9:14) An-Nisaa': (4:119)
12	Modern biology	The benefits of biotechnology	Al-Jaatsiyah: (45:13)

Data analysis

Regarding the method of analysis, the data obtained from study 2 were analysed using descriptive and

inferential statistics. Descriptive statistics include the mean (M) and standard deviation (SD) of students' scores in each class to show their overall understanding after being taught the integration of science and Islam. Because the way of teaching is a teacher characteristic that has to do with the pattern of integration explored in the first study, this analysis is intended to investigate the effectiveness of each pattern. In other words, this independent t-test analysis aims to identify the significant effect of different instructional teaching patterns and practices on student learning outcomes.

Results and Discussion

Study 1

Overall, the process of thematic content analysis that has been carried out reveals many themes that are broadly categorised under "meanings," "patterns," and "benefits" of the integration of Islamic worldviews in science classes.

Understanding of the integration of Islamic worldview and science class

Almost all teachers commented that integrating the Islamic worldview into the science class refers to interconnection, which means uniting the two into one unified whole. Some other teachers stated that they equated the integration of the Islamic worldview in science classes with integrated learning. Thus, this integration must involve several subjects to provide a meaningful learning experience for students. Finally, teachers believe that actualising Islamic values can be understood as a portrait of obedience vertically and horizontally in Islamic schools' learning context. Categories and teacher statements on the theme of understanding in more detail can be seen in [Table 3](#) and [Figure 1](#).

Table 3. Categories and Teacher Statements on the Theme of Understanding

No	Category	Teacher Statement
1	Eliminating the dichotomy between science and religion	<i>"In Islam, religious education is not distinguished from general education. Teachers' views and teaching activities should be no longer a dichotomy between the two and end this period" (G12)</i> <i>"Science and Islam can complement each other and be taught simultaneously. This is following the ideals of national education and also the goals of Islamic education to achieve prosperity in life in this world and the hereafter" (G16)</i>
2	As an integrated concept	<i>"We think that the integration of Islam and science does not evenly merge or combine them into one form of identical knowledge. We mean integrated by combining the character, style, and nature of the knowledge in all its unified dimensions" (G2)</i> <i>"Science teaching must be reviewed and modified so that it allows it to play a role in providing solutions to contemporary problems of society following Islamic studies. One of the example adalah pengintegrasian konsep dengan shalat dan puasa Ramadan" (G9)</i>
3	As a portrait of vertical and horizontal obedience	<i>"We believe that the basis for integrating Islamic values with science is based on Islamic teachings, which emphasise that humans will gain a high degree and dignity in the sight of Allah when they have faith and knowledge. The Qur'an is a guideline for the life of Muslims and is also related to the development of science to strengthen faith and improve human welfare" G3</i> <i>"This integration focuses on two things, namely vertical obedience is obedience to Allah as the creator, while horizontal obedience is obedience to ulil amri so that it is useful to fellow human beings" (G6)</i>

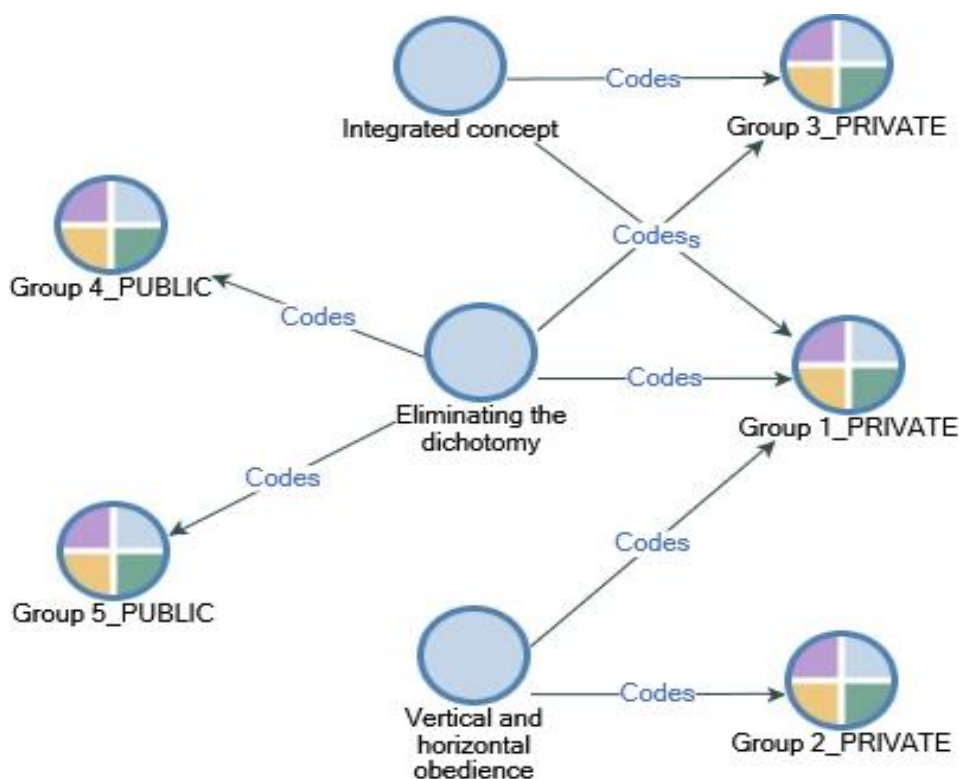


Figure 1. Teachers Understanding of Science and Islamic Integration

The integration pattern of Islamic worldview toward science class

It is considered that the integration of Islamic values must be included starting from the learning objectives that describe the cognitive domain. Almost all teachers gave a uniform statement that the Islamic worldview can be integrated as long as it is in line with general science material. Learning that integrates the Qur'an and Hadith or is based on revelation can be obtained by implementing effective strategies, approaches, and techniques in learning activities. Islamic worldview can be integrated into various kinds of student learning activities, and religious knowledge can be integrated into all learning activities, both in the initial (introduction), core, and final actions. The integration of Islamic values should also be included in evaluating learning outcomes. Categories and teacher statements on integration patterns in more detail can be seen in Table 4 and Figure 2.

Table 4. Categories and Teacher Statements on Pattern Themes

No	Category	Teacher Statement
1	Purpose	"Cognitive abilities can be formulated by directly covering two disciplines, science and religion. We formulate Biology learning objectives integrated with Islamic values, for example, explaining Q.S. Huud verse 44/Q.S. An-Nahl verse 10/Q.2. Ar-Ruum verse 48 and Q.S. An-Nuur verse 43 on certain stages of the hydrological cycle in everyday life" (G4)
2	Material	"We carry out integration regarding the curriculum of general science subjects. The rationale is that the teaching materials compiled are general science. Stated in terms of "adjustment" because the integrative material developed is not fully subject to the objectives and learning materials" (G10) "The description of the material depends on the extent to which information can be extracted from the Qur'an and hadith. This does not mean that the material discussion that takes place is about Islamic science; however, it is a discussion of general science which refers mainly sourced from the Qur'an and hadith" (G8) "Citing arguments from the Qur'an and hadith, which will be integrated into teaching materials, can be done in various patterns. For example, the contents of the verse correspond to related scientific material, so we quote it in its entirety. For example, the quote Q.S. Asy-Syu'araa (7): 'And do they not pay attention to the earth, how much We grow on the earth various kinds of good plants?'. All of these verses can be integrated into biodiversity teaching materials" (G6)
3	Step	"The delivery of science and Islam integrated material in core activities can be

No	Category	Teacher Statement
		<p><i>delivered directly by the teacher under the following conditions: (a) the teacher does not give prior assignments to students regarding the study of Islamic integration following science; (b) the teacher feels that it is difficult for students to get a discussion of religious knowledge following the science material to be studied, and (c) integrated material is given as a further explanation of the learning activities being carried out" (G17)</i></p> <p><i>"If students convey religious values, it is suggested that the assignment be carried out before the learning process takes place. In closing activities, the teacher can guide students to make conclusions about the material that has been learned supported by related arguments/paragraphs" (G15)</i></p>
4	Evaluation	<p>"Integration of the Islamic worldview into learning outcomes also needs to be done because the integration of religious knowledge must be formulated in the components of integrative learning objectives, for example, by compiling test items "on the hydrological cycle, there are Q.S. that describes a particular stage of the cycle. Explain the sequence of the hydrological cycle by including certain verses from the Qur'an as one of the explanations of the stages! (G13)</p>

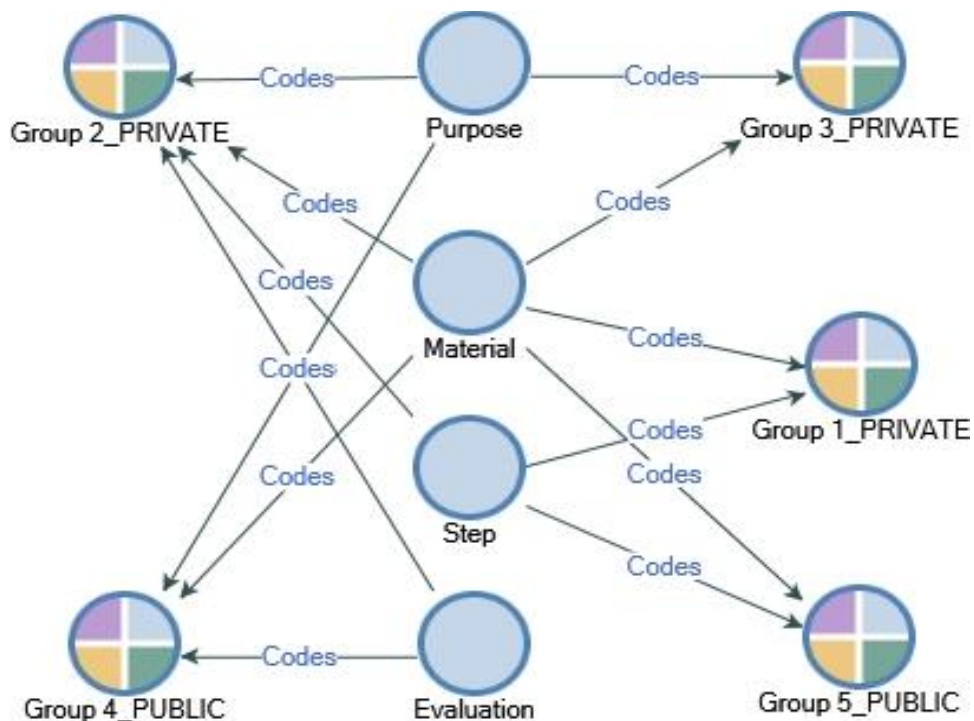


Figure 2. Teachers' Perspective on the Pattern of Science and Islamic Integration

Benefits of Integrating Islamic Worldview Against Science Class

Almost all lecturers agree that the purpose of learning the integration of science and Islam is to produce students who have an intellectual, emotional, spiritual, and physical balance based on faith in Allah. All teachers know that the Islamic religion's moral values and the Qur'anic approach influence student morality. The teacher concludes that efforts to integrate Islamic values in science classes are highly effective and attractive. Science teachers emphasise the priority of explaining scientific facts supported by relevant arguments, and this effort can strengthen students' views and opinions on a particular matter. Categories and teacher statements on integration patterns in more detail can be seen in [Table 5](#) and [Figure 3](#).

Table 5. Categories and Teacher Statements on the Theme of Benefits

No	Category	Teacher Statement
1	Develop a religious attitude	"We believe that Islamic education is not solely aimed at obtaining intellectual satisfaction, material or worldly achievements, but to form a human person who is rational and virtuous and knows Allah SWT as the creator of humans and the universe and must be based on unity, integration, sustainability, authenticity, practicality, solidarity and openness" (G1)
2	Instil commendable morals	"We apply Islamic value education to shape student character. Religious value education is always applied so that students' minds, with the help of conscience, can choose piety, goodness, honesty and truth" (G6) "The integration of planned values is oriented towards socio-religious attitudes. We are of the view that this goal can guide us to make pedagogical decisions, especially scientific issues related to religion" (G7)
3	Strengthen content understanding	"We realise that integrated learning can increase the meaningfulness of the learning material to be studied. We firmly believe that the Qur'an is compatible with modern science. The consequence of this is increasing students to learn science" (G11) "In general, the integration of science and Islam does not only increase religious attitudes and positive attitudes but can increase science learning achievement" (G4)
4	Strengthen skills	"We hope that the acquisition and attainment of knowledge related to science and Islamic values that lead to social attitudes is an important factor that is of concern to teachers and will affect the implementation of learning in the classroom, which will ultimately affect students' ways of thinking and learning" (G13) "Learning with the integration of Islam and science provides positive results in forming individuals who are tough in applying knowledge following Islam" (G10)

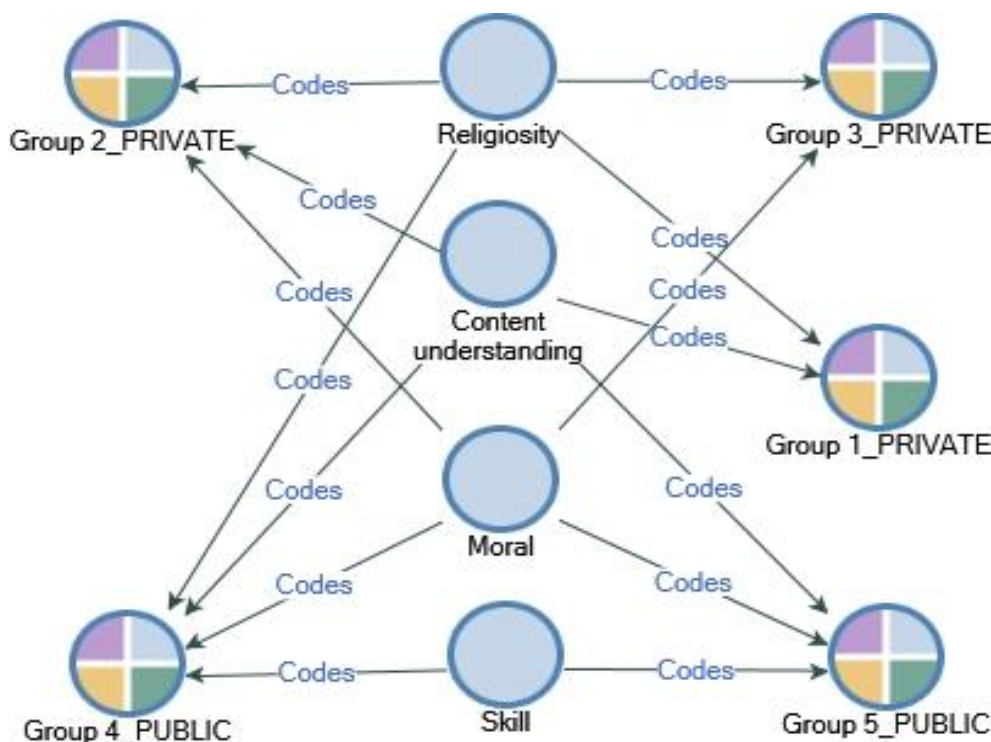


Figure 3. Teachers' Opinions on Science and Islamic Integration Benefits

Study 2

In the following, we present the results of a supplementary survey based on an analysis of cognitive tests on two groups of students taught different integration patterns, namely patterns A and B. For grade 10, students in group A had a score ($M= 42.07$; $SD= 7.27$) higher than group B ($M= 27.90$; $SD= 12.65$).

Similar to grade 10, scores in group A in grades 11 ($M= 43.04$; $SD= 9.77$) and 12 ($M= 48.72$; $SD= 7.09$) were higher than those in group B with $M= 26.79$ ($SD=6.96$) in class 11 and $M= 26.53$ ($SD= 5.81$) in grade 12. In summary, all groups that were taught the all-integrated pattern (which we call pattern A) at all grade levels had higher mean scores than students who were given teaching with integration patterns only on learning materials (which we call pattern B). The results of descriptive statistical tests are briefly presented in [Table 6](#).

Table 6. Summary of Descriptive Statistical Test Results on Students' Understanding Scores

Class	10		11		12	
	A	B	A	B	A	B
Pattern						
Means	42.07	27.90	43.04	26.79	48.72	26.53
Std. Deviation	7.27	12.65	9.77	6.96	7.09	5.81
Minimum	30.00	8.00	25.00	12.00	37.00	15.00
Maximum	56.00	55.00	58.00	38.00	60.00	35.00

Before testing, the data were analysed for normality requirements using the one-sample Kolmogorov-Smirnov test. The results show that the cognitive test data in all classes meet these assumptions with a p -value of more than 0.05 ([Table 7](#)). The results of the independent t-test to highlight the differences between the two groups of students at all grade levels show that the support for a more comprehensive integration pattern has a significant effect on students' understanding of the material with a p -value of 0.000. The results of the t-test are briefly presented in [Table 8](#).

Table 7. Summary of Normality Test Results on Student Understanding Scores

Class		10	11	12
N		60	55	64
Normal Parameters	Mean	34.98	34.76	37.62
	Std. Deviation	12.47	11.72	12.89
Most Extreme Differences	Absolute	.077	.091	.109
	Positive	.077	.091	.109
	Negative	-.072	-.085	-.083
Test Statistic		.077	.091	.109
Asymp. Sig. (2-tailed)		.200	.200	.058

Table 8. Summary of Descriptive Statistical Test Results on Students' Understanding Scores

Class	t-test for Equality of Means						
	t	df	Sig. (2-tailed)	Mean difference	Std. Error difference	95% Confidence Interval of the Difference	
						Lower	Upper
10	-5.32	58	0.000	-14.17	2.66	-19.50	-8.84
11	-7.12	53	0.000	-16.25	2.28	-20.82	-11.67
12	-13.68	62	0.000	-22.19	1.62	-25.43	-18.95

One of the main reasons for Islamic high schools to integrate the Islamic worldview into science classes is to increase students' religious attitudes and character as a counterbalance to their understanding of science ([Hidayat et al., 2020](#)). Therefore, it is vital to explore the experiences of science teachers and their impact on student learning outcomes and use them as a basis for making significant changes to the curriculum.

In Study 1, we believe teachers are significant knowledge producers ([Loughran, 2011](#)) so the main highlight is their perspective. The findings from study 1 show several vital words articulated by teachers in conveying their opinions about the concept of integration of Islam and science, including eliminating the dichotomy between science and Islamic science, integration as an integrated learning concept, and viewing this integration as a concept of a balance of obedience. Furthermore, for the findings of integration patterns, teachers believe that this integration can be carried out starting from the planning stages of objectives, mapping of materials, implementation in learning steps, to evaluation. Finally, related to the benefits, the teachers gave their opinion that integration can improve religious attitudes, noble character, understanding of the material, and development of skills.

Our view is that the concept of integration of the Islamic worldview is the result of the development of religion-based education, which is developing very rapidly in Indonesia ([Suyadi et al., 2022](#)). Islamic schools have played an essential role in the life of Indonesian society. Currently, Islamic schools are required to embrace reform and begin a phase toward the demands of learning modern science while still prioritising Islamic values ([Qoyyimah, 2018](#)). This effort has had an extraordinary impact, especially in providing the view that science is in line with the propositions in the Islamic religion without any dichotomy ([El-Yousfi, 2021](#); [Mufid, 2014](#)). In fact, both can be studied simultaneously to build a

comprehensive student character. Islamic worldview integration should not be seen as a complement to religion in Islamic schools, but this is also supported by a curriculum that supports horizontal and vertical obedience in a balanced manner (Oktar, 2022).

Several assumptions could undermine the integration of the Islamic worldview of science classes into learning objectives and pace, and these areas require special attention by schools and science teachers: (1) The idea is that the Islamic worldview can only be expressed in learning objectives related to affective and cognitive aspects; and (2) In the learning step, students can only express the integration of Islam following science if they have been given assignments before.

Regarding integration patterns, teachers have had Islamic absorption, which is not just teaching content but is spread throughout the curriculum approach (Purwati et al., 2018). The practice of integration in learning materials has been well-mapped according to the essence of the verse and its meaning. Schools can take advantage of the experience of senior religion teachers in assisting science teachers in increasing their understanding of the Islamic worldview and its potential benefits (Abdalla et al., 2022). Indonesian education has prioritised highly developed and responsive pedagogical practices to align science and Islamic values (Chanifah et al., 2021). Viewed from the aspect of benefits, teachers have given their view that the integration of Islamic worldviews into science classes has a considerable influence. Like previous research (Suryaningsih et al., 2021), the teachers have clearly explained the benefits of student knowledge but have not thoroughly explained the effect on aspects of skills.

Regarding the benefits of knowledge, study 2 focuses on the influence of teacher-designed integration patterns that can support the development of students' understanding of content. The results show that students taught with pattern A have higher scores than those prepared with pattern B at all grade levels in Islamic senior high schools. Burroughs et al., (2019) explain that teacher instructional behaviour, such as teaching readiness (setting goals for evaluation), has a consistent relationship with student learning outcomes. Other studies have also shown identical results but found a weak relationship (Polikoff & Porter, 2014). Meanwhile, students taught with pattern B had low scores because content preparation was described as having an indirect effect on student learning outcomes (Schmidt et al., 2017), and even prior research failed to prove the effect of teacher content preparation on student comprehension (Blazar, 2015).

Our findings showed that science teachers need support in terms of directing Islamic worldviews in science classes. Teachers need to be improved pedagogy to enhance learning towards developing skills that can contextualise Islamic values in a relevant way. This should lead to a pedagogy (including the delivery of content and the models used) that involve deep thinking of teachers in using reason and grounded argumentation. Faced with this situation, teachers can consider a collaborative planning process (Chan & Erduran, 2022) which focuses on updating the curriculum design on the front (objectives) as well as the alignment of assessments that make it possible to measure student skills. In another sense, achieving comprehensive results requires the teacher's understanding of the meaning, goals, and expected outcomes of integrating the Islamic worldview and science.

This research provides a door into what Islamic integrated science education looks like in Biology class practice in Islamic high schools and focuses more than just integrating it into learning materials. Our findings show that there are several patterns in terms of the integration of the Islamic worldview into science classes. Furthermore, this integration pattern appears related to teachers' ability and awareness of how to make a close relationship between science and Islam. If the teacher has the ability and realises that this integration effort provides optimal benefits to student learning outcomes, the science teacher will probably implement this integration starting from planning objectives, materials, steps, and learning evaluation. Not only focused on learning materials, as revealed by previous research (Wasehudin et al., 2022).

Related to generalisations, the findings presented in this study provide valuable information for policymakers and high school science teachers that there are several challenges in implementing the integration of the Islamic worldview in science classes, especially the thorough application of goal formulation to evaluation leading to skills development. In addition, although this work is limited to the perspectives and experiences of Biology teachers, almost all of the themes created during the analysis process do not lead to content. Therefore, the results of our work can explain, in general, what happens to all science teachers in terms of introducing integrated or integrated learning.

Conclusion

This research explored the experiences of science teachers regarding the application of the integration of Islam and science and its influence on students' understanding. Study 1 was conducted using the phenomenological methodology, and the findings revealed three things following the research questions posed: (1) the concept of science integration is analogous to integrated learning, (2) science teachers apply integration patterns that are more focused on learning materials, and (3) teachers are optimistic about the effect of the integration of Islamic worldview and science on the learning outcomes of their students. The findings reveal a single point of view regarding the integration of science and Islam among

science teachers. It provides a unique description that the integration of science and Islam provides a balanced portrait of religious observance and eliminates the dichotomy between the two.

Along with this description, study 2 provides insight that it is necessary to emphasise integration patterns in every aspect of learning to optimise student skill development. This follow-up research provides an understanding of the influence of integration patterns on student learning outcomes. The findings from this study indicate that teachers who apply a particular integration pattern to all aspects of learning provide meaningful and authentic learning that can direct students to make explicit connections between science and Islam, which is the key to learning science in Islamic education.

Of course, we also realise that this research does not attempt to capture teachers' abilities to design and conduct lessons. Our findings only provide examples of integration patterns where teachers incorporate Islamic worldviews into science learning materials and what benefits science teachers expect from this effort. This phenomenological work focused on the perspectives and reflections of science teachers on their experiences with implementing the integration of science and Islam. Future work needs to explore how teachers' perspectives can relate to the patterns of integration they have applied so far. By utilising strong quantitative measurements, researchers can accurately describe the correlation between the perspectives and experiences of science teachers. Quantitatively assessing the perspective (attitude) and experience (behaviour) aspects of Islamic integrated science education is challenging due to the limited instruments, such as valid and reliable questionnaires based on rigorous psychometric analysis. Another potential limitation is that the teacher's experience may very well be "culturally linked" so that the perceptions articulated by science teachers in Indonesia may be different from science teachers applying the same pattern in other countries. Recognising that differences in curricula influence classroom pedagogy, science teachers in Indonesia may tend to be easier to implement to have a significant impact on student learning outcomes. Lastly, this research only involved science teachers, and further research is needed to assess and explore from the side of religious teachers whether there is a relationship between the learning patterns they apply and student learning outcomes.

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Author Contributions

J. Sahil: methodology, writing original draft preparation, and review and editing. **S. Zubaidah:** methodology, writing original draft preparation, and review and editing. **A. D. Corebima:** methodology, writing original draft preparation. **A. Gofur:** methodology, writing original draft preparation. **M. Saefi:** analysis; writing original draft preparation, and review and editing.

References

- Abdalla, M., Chown, D., & Memon, N. (2022). Islamic studies in Australian Islamic schools: Educator voice. *Journal of Religious Education*, 70(1), 25–42. <https://doi.org/10.1007/s40839-022-00164-y>
- Abedin, M., Islam, M. A., Rahman, F. N., Reza, H. M., Hossain, M. Z., Hossain, M. A., Arefin, A., & Hossain, A. (2021). Willingness to vaccinate against COVID-19 among Bangladeshi adults: Understanding the strategies to optimize vaccination coverage. *PLOS ONE*, 16(4), e0250495. <https://doi.org/10.1371/journal.pone.0250495>
- Akkari, A., & Radhouane, M. (2022). The difficulty of integrating religious diversity into intercultural approaches to education. In A. Akkari & M. Radhouane (Eds.), *Intercultural Approaches to Education: From Theory to Practice* (pp. 147–162). Springer International Publishing. https://doi.org/10.1007/978-3-030-70825-2_11
- Alam, N. A. R., & Rachmadhani, F. (2021). The practice of science and religion integration: Students' perspective on Muhammadiyah Pesantren. *At-Ta'dib*, 16(2), Article 2. <https://doi.org/10.21111/at-tadib.v16i2.6896>

- Alassiri, M. (2020). Evolution is the disguised friend of Islam. *Nature Human Behaviour*, 4(2), Article 2. <https://doi.org/10.1038/s41562-019-0771-7>
- Albanesi, C. (2014). Focus Groups. In A. C. Michalos (Ed.), *Encyclopedia of quality of life and well-being research* (pp. 2310–2313). Springer Netherlands. https://doi.org/10.1007/978-94-007-0753-5_1066
- Avraamidou, L. (2020). "I am a young immigrant woman doing physics and on top of that I am Muslim": Identities, intersections, and negotiations. *Journal of Research in Science Teaching*, 57(3), 311–341. <https://doi.org/10.1002/tea.21593>
- Azra, H. (2018). Islamic education in Indonesia. In H. Daun & R. Arjmand (Eds.), *Handbook of Islamic Education* (pp. 763–780). Springer International Publishing. https://doi.org/10.1007/978-3-319-64683-1_32
- Blazar, D. (2015). Effective teaching in elementary mathematics: Identifying classroom practices that support student achievement. *Economics of Education Review*, 48, 16–29. <https://doi.org/10.1016/j.econedurev.2015.05.005>
- Burroughs, N., Gardner, J., Lee, Y., Guo, S., Touitou, I., Jansen, K., & Schmidt, W. (2019). A review of the literature on teacher effectiveness and student outcomes. In N. Burroughs, J. Gardner, Y. Lee, S. Guo, I. Touitou, K. Jansen, & W. Schmidt (Eds.), *Teaching for Excellence and Equity: Analyzing Teacher Characteristics, Behaviors and Student Outcomes with TIMSS* (pp. 7–17). Springer International Publishing. https://doi.org/10.1007/978-3-030-16151-4_2
- Chan, J., & Erduran, S. (2022). The Impact of collaboration between science and religious education teachers on their understanding and views of argumentation. *Research in Science Education*. <https://doi.org/10.1007/s11165-022-10041-1>
- Chan, J., & Erduran, S. (2023). The impact of collaboration between science and religious education teachers on their understanding and views of argumentation. *Research in Science Education*, 53(1), 121–137. <https://doi.org/10.1007/s11165-022-10041-1>
- Chanifah, N., Hanafi, Y., Mahfud, C., & Samsudin, A. (2021). Designing a spirituality-based Islamic education framework for young muslim generations: A case study from two Indonesian universities. *Higher Education Pedagogies*, 6(1), 195–211. <https://doi.org/10.1080/23752696.2021.1960879>
- Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed). Pearson.
- Dajani, R. (2022). Science and religion complement each other, not compete with one another. In M. Fuller, D. Evers, & A. Runehov (Eds.), *Issues in Science and Theology: Creative Pluralism? : Images and Models in Science and Religion* (pp. 23–31). Springer International Publishing. https://doi.org/10.1007/978-3-031-06277-3_3
- Daulay, H., & Tobroni, T. (2017, December 1). *Islamic education In Indonesia: A Historical Analysis Of Development And Dynamics*. <https://www.semanticscholar.org/paper/Islamic-Education-In-Indonesia%3A-A-Historical-Of-And-Daulay-Tobroni/e83b7deb6fa9681240c27946970506c830d708a8>
- De Cruz, H. (2022). Religion and science. In E. N. Zalta & U. Nodelman (Eds.), *The Stanford Encyclopedia of Philosophy* (Fall 2022). Metaphysics RESEARCH Lab, Stanford University. <https://plato.stanford.edu/archives/fall2022/entries/religion-science/>
- Eddles-Hirsch, K. (2015). Phenomenology and educational research. *International Journal of Advanced Research*, 3(8). https://researchonline.nd.edu.au/edu_article/171
- Edis, T. (2023). Islam's Encounter with modern science: A mismatch made in heaven. *Elements in Islam and Science*. <https://doi.org/10.1017/9781009257473>
- Eeuwijk, P., & Angehrn, Z. (2017). *How to conduct a focus group discussion (FGD)*. *Methodological manual* (Published Research Report). University of Basel. <https://www.zora.uzh.ch/id/eprint/150640/>
- El-Yousfi, A. (2021). Muslims and mosques in France: Navigating the 'cultural/religious' dichotomy through God's witnessing and the holism of Islam. *Religion, State and Society*, 49(4–5), 297–313. <https://doi.org/10.1080/09637494.2021.1999124>
- Fahyuni, E. F., Wasis, W., Bandono, A., & Arifin, M. B. U. B. (2020). Integrating Islamic values and science for millennial students learning on using seamless mobile media. *Jurnal Pendidikan IPA Indonesia*, 9(2), Article 2. <https://doi.org/10.15294/jpii.v9i2.23209>

- Hefner, R. W. (2020). Islam and Covenantal pluralism in Indonesia: A critical juncture analysis. *The Review of Faith & International Affairs*, 18(2), 1–17. <https://doi.org/10.1080/15570274.2020.1753946>
- Hidayat, M., Arifin, S., Asrori, A., & Rusman. (2020). *Integration science technology with Islamic values: Empowering education model*. <https://doi.org/10.2991/assehr.k.200529.202>
- Hill, H. C., & Chin, M. (2018). Connections between teachers' knowledge of students, instruction, and achievement outcomes. *American Educational Research Journal*, 55(5), 1076–1112. <https://doi.org/10.3102/0002831218769614>
- Husamah, H., Suwono, H., Nur, H., & Dharmawan, A. (2022). Innovation integration of Islamic values in learning environmental themes in biology education. *JINoP (Jurnal Inovasi Pembelajaran)*, 8(1), Article 1. <https://doi.org/10.22219/jinop.v8i1.19565>
- Hyman, M., & Sierra, J. (2016). Open- versus close-ended survey questions. *NMSU Business Outlook*, 14.
- Klinke, M. E., & Fernandez, A. V. (2022). Taking phenomenology beyond the first-person perspective: Conceptual grounding in the collection and analysis of observational evidence. *Phenomenology and the Cognitive Sciences*. <https://doi.org/10.1007/s11097-021-09796-1>
- König, J., Blömeke, S., Jentsch, A., Schlesinger, L., née Nehls, C. F., Musekamp, F., & Kaiser, G. (2021). The links between pedagogical competence, instructional quality, and mathematics achievement in the lower secondary classroom. *Educational Studies in Mathematics*, 107(1), 189–212. <https://doi.org/10.1007/s10649-020-10021-0>
- Leicht, C., Sharp, C. A., LaBouff, J. P., Zarzeczna, N., & Elsdon-Baker, F. (2022). Content matters: Perceptions of the science-religion relationship. *The International Journal for the Psychology of Religion*, 32(3), 232–255. <https://doi.org/10.1080/10508619.2021.2003111>
- Loughran, J. (2011). Science teacher learning. In M. M. H. Cheng & W. W. M. So (Eds.), *Science Education in international contexts* (pp. 131–141). SensePublishers. https://doi.org/10.1007/978-94-6091-427-0_10
- Lukens-Bull, R., & Woodward, M. (2020). Variation of Muslim practice in Indonesia. In R. Lukens-Bull & M. Woodward (Eds.), *Handbook of Contemporary Islam and Muslim Lives* (pp. 1–23). Springer International Publishing. https://doi.org/10.1007/978-3-319-73653-2_78-1
- Malik, S. A. (2023). Introduction to the special issue on philosophy of science and Islamic thought. *Theology and Science*, 21(3), 354–358. <https://doi.org/10.1080/14746700.2023.2230425>
- Mufid, F. (2014). Islamic SCIENCES INTEGRATION. *QIJIS (Qudus International Journal of Islamic Studies)*, 2(2), Article 2. <https://doi.org/10.21043/qijis.v2i2.1565>
- Neubauer, B. E., Witkop, C. T., & Varpio, L. (2019). How phenomenology can help us learn from the experiences of others. *Perspectives on Medical Education*, 8(2), 90–97. <https://doi.org/10.1007/s40037-019-0509-2>
- Ningsih, T., Purnomo, S., Muflihah, M., & Wijayanti, D. (2022). Integration of science and religion in value education. *IJORER: International Journal of Recent Educational Research*, 3(5), 569–583. <https://doi.org/10.46245/ijorer.v3i5.248>
- Oktar, S. (2022). Madrasaty: A new model of Islamic higher education integrating religion and science inspired by madrasah and university. *Katre Uluslararası İnsan Araştırmaları Dergisi*, 13, 32–62. <https://doi.org/10.53427/katre.1089699>
- Page, M. (2023). How to make analytic science-engaged theology an ASSET. *TheoLogica: An International Journal for Philosophy of Religion and Philosophical Theology*, 7. <https://doi.org/10.14428/thl.v7i1.63153>
- Peters, T. (2017). Science and religion: Ten models of war, truce, and partnership. *Theology and Science*, 16, 1–43. <https://doi.org/10.1080/14746700.2017.1402163>
- Polikoff, M. S., & Porter, A. C. (2014). Instructional alignment as a measure of teaching quality. *Educational Evaluation and Policy Analysis*, 36(4), 399–416. <https://doi.org/10.3102/0162373714531851>
- Purwati, N., Zubaidah, S., Corebima, A. D., & Mahanal, S. (2018). Increasing Islamic junior high school students learning outcomes through integration of science learning and Islamic values. *International Journal of Instruction*, 11(4), 841–854. <https://doi.org/10.12973/iji.2018.11453a>

- Qoyyimah, U. (2018). Policy implementation within the frame of school-based curriculum: A comparison of public school and Islamic private school teachers in East Java, Indonesia. *Compare: A Journal of Comparative and International Education*, 48(4), 571–589. <https://doi.org/10.1080/03057925.2017.1334536>
- Ridwan, R., & Diantimala, Y. (2021). The positive role of religiosity in dealing with academic dishonesty. *Cogent Business & Management*, 8(1), 1875541. <https://doi.org/10.1080/23311975.2021.1875541>
- Roth, W.-M. (2010). Science and religion: What is at stake? *Cultural Studies of Science Education*, 5(1), 5–17. <https://doi.org/10.1007/s11422-009-9234-1>
- Schmidt, W. H., Burroughs, N. A., Cogan, L. S., & Houang, R. T. (2017). The role of subject-matter content in teacher preparation: An international perspective for mathematics. *Journal of Curriculum Studies*, 49(2), 111–131. <https://doi.org/10.1080/00220272.2016.1153153>
- Sim, J., & Waterfield, J. (2019). Focus group methodology: Some ethical challenges. *Quality & Quantity*, 53(6), 3003–3022. <https://doi.org/10.1007/s11135-019-00914-5>
- Sozibilir, M., Kutu, H., & Yasar, M. D. (2012). Science education research in Turkey: A content analysis of selected features of published papers. In D. Jorde & J. Dillon (Eds.), *Science Education Research and Practice in Europe* (pp. 341–374). SensePublishers. https://doi.org/10.1007/978-94-6091-900-8_14
- Suciati, R., Gofur, A., Susilo, H., & Lestari, U. (2022). Development of textbook integrated of metacognition, critical thinking, Islamic values, and character. *Pegem Journal of Education and Instruction*, 12(4), 20–28. <https://doi.org/10.47750/pegegog.12.04.03>
- Suciati, R., Susilo, H., Gofur, A., Lestari, U., & Rohman, I. (2022). Millennial students' perception on the integration of Islam and science in Islamic universities. *Indonesian Journal of Islam and Muslim Societies*, 12(1), Article 1. <https://doi.org/10.18326/ijims.v12i1.31-57>
- Sujarwoto, Saputri, R. A. M., & Yumarni, T. (2021). Social media addiction and mental health among university students during the COVID-19 pandemic in Indonesia. *International Journal of Mental Health and Addiction*. <https://doi.org/10.1007/s11469-021-00582-3>
- Suleymanova, D. (2020). Pedagogy of Islam: Madrasa education and moral upbringing. In D. Suleymanova (Ed.), *Pedagogies of Culture: Schooling and Identity in Post-Soviet Tatarstan, Russia* (pp. 151–172). Springer International Publishing. https://doi.org/10.1007/978-3-030-27245-6_5
- Suryaningsih, S., Muslim, B., & Fitriani, V. (2021). Integration of Islam and science in biochemistry course. In *Emerging Trends in Technology for Education in an Uncertain World* (pp. 70–77). Routledge. <https://doi.org/10.1201/9781003219248-9>
- Suyadi, Nuryana, Z., Sutrisno, & Baidi. (2022). Academic reform and sustainability of Islamic higher education in Indonesia. *International Journal of Educational Development*, 89, 102534. <https://doi.org/10.1016/j.ijedudev.2021.102534>
- Swain, K., Pendergast, D., & Cumming, J. (2018). Student experiences of NAPLAN: Sharing insights from two school sites. *The Australian Educational Researcher*, 45. <https://doi.org/10.1007/s13384-017-0256-5>
- Taber, K. S. (2015). Affect and meeting the needs of the gifted chemistry learner: Providing Intellectual challenge to engage students in enjoyable learning. In M. Kahveci & M. Orgill (Eds.), *Affective Dimensions in Chemistry Education* (pp. 133–158). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-662-45085-7_7
- Trevors, J. T., & Saier, M. H. (2010). Science and religion: Two products of human imagination. *Water, Air, and Soil Pollution*, 205(1), 23–25. <https://doi.org/10.1007/s11270-007-9378-0>
- Utami, P. T. (2022). Raising religious inherency: The role of interreligious competence in achieving religious education equality in multireligious public schools in Indonesia. *Humanities and Social Sciences Communications*, 9(1), Article 1. <https://doi.org/10.1057/s41599-022-01298-y>
- Wakhidah, N., & Erman, E. (2022). Examining environmental education content on Indonesian Islamic religious curriculum and its implementation in life. *Cogent Education*, 9(1), 2034244. <https://doi.org/10.1080/2331186X.2022.2034244>
- Wasehudin, W., Syah, D., Rahman, M. T., & Hasanah, U. (2022). Developing class instruction for linking the Qur'an to biological science. *AL-ISHLAH: Jurnal Pendidikan*, 14(3), 3641–3658. <https://doi.org/10.35445/alishlah.v14i3.1662>

- Wulan, E. R., Gunawan, H., Fauziah, W., & Kratz, F. (2021). Integration of science, technology, and Islamic values to enhance expected learning outcomes in French higher education. *Jurnal Pendidikan Islam*, 7(1), Article 1. <https://doi.org/10.15575/jpi.v7i1.12765>
- Zaini, M., & Syafaruddin, S. (2020). The leadership behavior of madrasah principals in improving the quality of education in MAN 3 Medan. *Jurnal Iqra' : Kajian Ilmu Pendidikan*, 5, 95–106. <https://doi.org/10.25217/ji.v5i2.649>