

Generation Z Learning Style Adaptation Strategies in Islamic Religious Colleges: Neuroscience and Generative AI in Religious Education

Abdul Mukti ^{1*}, Ida Umami ², Ahmad Zumaro ², Dedi Wahyudi ²

¹ Universitas Yapis Papua, Indonesia

² UIN Jurai Siwo Lampung, Indonesia



muktirofzi@gmail.com*

ABSTRACT

The purpose of this study is to analyze the adaptation strategy of Islamic Religious Education (PAI) learning for Generation Z by integrating a neuroscience approach and the use of Generative Artificial Intelligence (AI). The background of the problem is the gap between the unique characteristics of Generation Z (digital native, short attention span, visual-spatial) and religious learning methods that are still conventional and textual. Previous studies have mostly discussed AI as an assistive tool or neuroscience separately, none of which has integrated the two to map the concrete learning styles of Generation Z in the context of Islamic religious education. This research method uses a qualitative approach with a case study design in three PTKI (Islamic Religious Colleges) in Lampung. Data were collected through participatory observation, in-depth interviews with lecturers and students, and analysis of Semester Learning Plan (RPS) documentation. Data analysis used the interactive model of Miles and Huberman combined with simple neural mapping techniques from observations of respondents' brain activity (through response tests and focus groups).

Keywords: Generation Z, Generative Ai, Generation Z Learning Style Adaptation, Neuroscience.

ARTICLE INFO

Article history:

Received
May 15, 2026
Revised
August 24, 2026
Accepted
September 25,
2026

Journal Homepage

<https://attractivejournal.com/index.php/aj/>

This is an open access article under the CC BY SA license

<https://creativecommons.org/licenses/by-sa/4.0/>

@ 2026 by the authors

Published by

CV. Creative Tugu Pena

INTRODUCTION

The demographic transformation of higher education in Indonesia is currently facing an unprecedented new reality. Data from the Central Statistics Agency (BPS) from the 2020 Population Census revealed that the composition of Indonesia's population is dominated by Generation Z (born between 1997–2012) which covers 27.94% of the total population, surpassing Millennials (25.87%), Generation X (21.88%), and other generations (BPS, 2026). This phenomenon is reinforced by data from the 2025 Intercensal Population Survey (SUPAS), which shows that Millennials and Generation Z groups make up the largest number of the total population of Jakarta, with percentages of 24.82% and 24.12%, respectively (Kompas.com, 2026). The implications of this demographic dominance for the world of education, especially Islamic Religious Higher Education (PTKI), are significant because the students who currently fill classrooms represent a generation that grew up with digital technology.

Generation Z, also known as iGen, GenZers, or Zoomers in international literature, (Pichler et al., 2021; Shatto & Erwin, 2016; Wiedmer & Delta, 2015) has characteristics that are fundamentally different from previous generations. They are the first generation to have never experienced a world without the internet (Kathleen et al., 2017). As digital natives (Michael, 2019), Gen Z reportedly spends up to nine hours daily on digital media (Shorey et al., 2021), using platforms like Snapchat, Instagram, TikTok, and YouTube for entertainment,

communication, and information (Rue, 2018; Shatto & Erwin, 2016). These characteristics shape cognitive patterns, social behaviors, and educational expectations that are very different from the current generation of lecturers, who are largely from Generation X and Millennials (Muff & Narbel, 2020; Silveira, 2021).

The most fundamental gap between Gen Z characteristics and the Islamic Religious Education (PAI) learning methods still dominant in Islamic Higher Education Institutions (PTKI) lies in three main aspects. First, attention span. Research (Hampton & Keys, 2016a) documented that the average human attention span has contracted generationally, from 12 seconds in Millennials to about 8 seconds in Gen Z. This finding was confirmed by a study (Sriram, 2023) in the British Journal of Multidisciplinary and Advanced Studies which showed that intense social media use significantly impairs the ability to delay gratification and sustain attention among adolescents. Meanwhile, conventional Islamic Education learning methods still rely heavily on lengthy lectures, extensive text reading, and memorization that require sustained concentration, a counterproductive mismatch.

Second, from the learning style preference perspective (Vizcaya-Moreno & Pérez-Cañaveras, 2020a) that Gen Z students show a clear preference for learning environments integrated with social media and technology-based instruction over traditional face-to-face teaching methods. Research on Gen Z learning preferences also reveals that they have a strong inclination towards multimedia content, short-form formats, and visual stimuli (Lai & Hong, 2015). One study (Poláková & Klímová, 2019) confirms that Gen Z is the first generation whose digital literacy is not just a learned skill but a fundamental epistemic framework.

Third, in terms of the need for feedback. Gen Z expects instant access to information and rapid feedback (Serebro et al., 2024), often preferring dynamic digital content over traditional pedagogical resources like textbooks (Kasneci et al., 2023). This characteristic contrasts with the Islamic Religious Education (PAI) learning evaluation system, which is still periodic (mid-term and final) with long time lags between completing assignments and receiving feedback. The mismatch between Gen Z characteristics and existing Islamic Education learning methods is exacerbated by the phenomenon of digital multitasking that has become a daily habit for students. Cognitive Load Theory (CLT) formulated by (Sweller, 1988) in Cognitive Science provides a neurocognitive framework for understanding the limitations of human learning capacity under conditions of multitasking and information overload (Sweller, 1988) demonstrating that human working memory is very limited in capacity and duration, and excessive cognitive load, especially extraneous load arising from poorly designed instructional materials or environmental distractions, significantly impairs learning and knowledge transfer. Research (Ophir et al., 2009) shows that chronic media multitaskers exhibit reduced cognitive control and inferior performance on tasks requiring sustained attention.

In the context of Islamic Religious Education, the implications of these findings are profound. The simultaneous presence of notifications, social media, and digital religious content creates an environment with high extraneous load that can undermine the contemplative processes and deep processing required by Quran memorization (tahfidz) and mastery of Islamic jurisprudence (fiqh). The study (Mark et al., 2018) also found that interrupted work leads to significant increases in time pressure and psychological stress, with each interruption requiring an average of 23 minutes to regain full cognitive focus, a finding that challenges the myth of productive multitasking in educational settings.

Amid these challenges, two innovative approaches have emerged as potential solutions: educational neuroscience (neuropedagogy) and Generative Artificial Intelligence (GenAI). Neuropedagogy systematically translates brain science findings into evidence-based instructional design (Serebro et al., 2024). Meanwhile, the emergence of Generative Artificial Intelligence (GenAI) as a transformative force in education represents one of the most significant pedagogical disruptions of the 21st century. A pivotal moment occurred with the release of ChatGPT by OpenAI in November 2022, which catalyzed the unprecedented proliferation of GenAI tools across all education sectors (Kasneci et al., 2023; Sriram, 2023). Research (Y. Wu, 2023) through meta-analysis confirmed that AI chatbots can improve student learning outcomes under the right conditions (Xia et al., 2023) and also found that AI chatbot

interactions mediate self-regulated learning by satisfying students' psychological needs for autonomy, competence, and relatedness, a crucial finding for the context of Islamic education where self-directed learning is highly valued.

However, the integration of AI in Islamic religious education faces unique ethical and theological challenges. Another study, (Elmahjub, 2023) proposing a pluralist ethical benchmarking framework for AI based on Islamic ethical traditions, is one of the first systematic attempts to apply the *maqasid al-shariah* (the objectives of Sharia: protection of religion, life, intellect, progeny, and property) to AI governance. Research on AI ethics from an Islamic perspective (Masruroh & Anam, 2023) explicitly applies the *maqasid al-shariah* to AI development, arguing that AI in an Islamic context must demonstrate *ta'adul* (justice), *shura* (deliberation), and *amanah* (trustworthiness) at the algorithmic level. The phenomenon of AI hallucination, *generating* plausible but factually incorrect, engineered, or misleading output, poses a particularly acute risk in the domain of Islamic religious content, where accuracy, source attribution, and authority of expertise and scholarship carry profound theological, legal, and spiritual consequences (Michael, 2019). presented the Aftina system specifically developed to enhance stability and prevent hallucinations in the AI-based Islamic fatwa generation process using Large Language Models (LLMs) and Retrieval-Augmented Generation (RAG).

The novelty of this research lies in the simultaneous integration of neuroscience and Generative AI within the Islamic Education (PAI) pedagogical framework for Generation Z, something that has not been done by previous research. Previous studies still separate the study of AI (focusing on technology) and neuroscience (focusing on cognitive psychology) in education. In the context of PTKI Lampung, there has been no research that specifically examines strategies for adapting to Gen Z's learning styles by integrating these two approaches. In fact, Lampung Province, with its diverse PTKI (UIN Jurai Siwo, UIN Raden Intan, Unisla, IAIM NU Metro, and other private PTKI) has unique sociocultural characteristics and access to technology, thus requiring in-depth contextual studies. Based on these theoretical and empirical gaps, this study aims to analyze the adaptation strategy for Islamic Religious Education learning for Generation Z through the integration of neuroscience approaches and the use of Generative Artificial Intelligence in three PTKI in Lampung Province.

LITERATURE REVIEW

Generation Z

Generation Z refers to individuals born between 1997 and 2012, a period that reflects progress in socioeconomic stability and rapid developments in information technology (Wiedmer & Delta, 2015; Xia et al., 2023). In Indonesia, there are approximately 68 million members of Gen Z (Angelina & Astuti, 2024), while globally the number of Gen Z is estimated to reach 2 billion people (Rue, 2018). Based on this definition, in 2023 the Gen Z group consists of teenagers aged between 13 and 24 years, who in the Indonesian education system are at the level from junior high school to early college graduates (Nurgiansah et al., 2020). BPS data from the 2020 Population Census revealed that the majority of Indonesia's population is from Generation Z, which covers 27.94% of the total population, followed by Millennials (25.87%), Generation X (21.88%), Baby Boomers (11.56%), and Post-Generation Z (10.88%) (BPS, 2026). This means that Gen Z is now the largest population group in Indonesia and plays a significant role in driving the country's development, both now and in the future.

Characteristics of Generation Z

The characteristics of a generation are influenced by behavioral patterns and the environment around them. Generation Z shows striking differences compared to other generations, especially due to the more dominant influence of technology and information (Taufikin et al., 2025). The characteristics of Generation Z include (Faizah & Sardi, 2026): (1) having a good understanding of the use of technology and having high aspirations; (2) starting to enter the world of higher education and the world of work; (3) being more willing to take risks than the millennial generation; (4) needing more support; (5) communication is more often done through digital platforms; (6) tending to have less developed social skills; (7) preferring to work individually.

In international literature, Gen Z is characterized by unparalleled diversity and digital fluency, as they have never known a world without the internet (Chan & Lee, 2023). As digital natives (Michael, 2019), they spend up to nine hours daily on digital media (Shorey et al., 2021), using platforms like Snapchat, Instagram, TikTok, and YouTube for entertainment, communication, and information. (Rue, 2018; R. Wu & Yu, 2024) They expect instant access to information and quick feedback, (Kathleen et al., 2017) often preferring dynamic digital content to traditional pedagogical resources like textbooks (Hampton & Keys, 2016b).

Research (Hans et al., 2023; Raymond, 2024) and (Šramková & Sirotiaková, 2021) provides a more detailed picture that Generation Z tends to express themselves through unique appearance, lifestyle, and interests, highly values collaboration, and is highly aware of social issues. In general, they have a profile that is very natural with technology, values collaborative consumption, and tends to be anxious about money and education.

Strauss-Howe Generation Theory

The Strauss-Howe generational theory argues that generational cohorts have distinct attitudes, behaviors, and value systems that cyclically shape social and organizational change. The theory identifies recurring generational archetypes (Baby Boomers, Gen X, Millennials, Gen Z), each with distinct attitudes, work values, and responses to leadership and technology (Strauss & Howe, 2015). These generational differences significantly shape how employees perceive digital leadership and engage in knowledge-sharing practices (Hans et al., 2023). Strauss-Howe's theory explains the transition of values and behaviors between generations through a recurring cycle of four phases (Prophet, Wanderer, Hero, Artist) that influence learning, work, and communication between generations (Strauss & Howe, 2015). The theory has been applied in studies of the cross-generational workforce, such as how organizations adapt when Baby Boomers and Generation Z work together. (Smith et al., 2018; Smith & Hill, 2019) and has informed the design of knowledge development policies that are in accordance with the dynamics of each generation (Enciso, 2024).

Although the Strauss-Howe generational cycle formulation has been influential in educational and sociological debates, it has also been criticized for its deterministic tendencies, Western-centered sampling, and the risk of overgeneralization of intra-cohort variability (Featherstone, 2005). Other studies (Treve, 2024) In a journal abstract, he proposed a counter-thesis that social cycles do exist, but their duration varies according to technological developments, communication speeds, and system complexity, so that cycles in pre-modern societies proceed more slowly, while in the modern era they have accelerated significantly.

Neuroscience in Education (Neuropedagogy)

Neuropedagogy, an interdisciplinary field at the intersection of neuroscience, cognitive psychology, and educational practice, has emerged as one of the most dynamic frontiers in contemporary pedagogy, systematically translating brain science findings into evidence-based instructional design (Raymond, 2024). A study, (Deryansyah et al., 2023; Šramková & Sirotiaková, 2021) published in *Frontiers in Education*, advocates for the systematic integration of neuropedagogical principles in pre-service teacher education, arguing that when teachers understand how the brain develops, learns, and consolidates memory, they become significantly more effective agents of pedagogical transformation.

Three fundamental studies have shaped the application of neuroscience to educational practice with particular authority: (Mark et al., 2018; Ophir et al., 2019) in *Teaching with the Brain in Mind* (ASCD) synthesizes decades of neuroscience research to argue that educators must design their instructional strategies around how the brain actually learns. Jensen identified that the brain's threat detection system (the amygdala) actively suppresses cortical learning when students feel unsafe, humiliated, or bored, an insight with profound implications for Islamic religion classes where punitive rote memorization practices can inadvertently trigger threat responses that undermine retention. (Bush & Saltarelli, 2022) In *How the Brain Learns*, Sousa offers a practical translation of cognitive neuroscience, articulating the brain's prime learning period (the primacy-recency effect), the neurological basis for meaning-making rather than mechanical memorization, and the role of sleep in memory consolidation. Sousa's primacy-recency effect, that students remember information best from the beginning and end of a lesson,

with the 'chaos in the middle' being neurologically most vulnerable, directly informs the design of PAI lesson plans for Gen Z learners with compressed attention spans.

(Swire-Thompson et al., 2025) provides the most comprehensive academic synthesis in the field, resulting in an integrated framework she calls Mind, Brain, and Education (MBE). Tokuhamma-Espinosa emphasizes that effective neuropedagogy must be culturally and contextually sensitive, an important reminder that neuroscientific principles developed primarily in secular Western laboratories require thoughtful adaptation when applied to an Islamic educational ecosystem shaped by theological anthropology, spiritual epistemology, and distinctive communal learning traditions.

Working Memory and Cognitive Load Theory

(Sippel et al., 2024) presented a working memory model that is one of the most empirically robust and influential theories of short-term cognitive processing in education. Baddeley revised and elaborated the initial model (Higgins et al., 2011), proposing a multi-component architecture consisting of: a phonological loop (for verbal and auditory information), a visuospatial sketchpad (for visual and spatial data), an episodic buffer (for integrating information across domains), and a central executive (an attentional control system that regulates all working memory operations).

This model has direct relevance to digital Islamic education: the phonological loop is activated during Qur'an recitation and listening; the visuospatial sketchpad processes the calligraphy and spatial layout of the mushaf pages; and the central executive, critically, is overloaded when learners try to simultaneously manage social media notifications, read Arabic text, and process teacher audio.

Cognitive Load Theory (CLT), formulated by (Sweller, 1988) in his 1988 foundational paper, provides a fundamental neurocognitive framework for understanding the limitations of human learning capacity. (Sweller, 1988) He demonstrated that human working memory is severely limited in capacity and duration, and that excessive cognitive load, particularly extraneous load arising from poorly designed instructional materials or environmental distractions, significantly impairs learning and knowledge transfer. The theory distinguishes three categories of cognitive load: intrinsic load (the inherent difficulty of a task), extraneous load (externally imposed cognitive interference), and germane load (processing devoted to schema formation and long-term memory consolidation).

Spaced Repetition and the Neuroscience of Quran Memorization

The neuroscience of memory consolidation provides strong empirical support for the ancient practice of muraja'ah (repetition and review of the Qur'an), revealing a profound convergence between traditional Islamic pedagogical methods and modern cognitive science. Spaced repetition, the practice of reviewing material at increasing intervals, timed precisely when natural forgetting begins to occur, has been established by decades of research as the most effective strategy for long-term memory retention (Poláková & Klímová, 2019).

At the neurobiological level, spaced repetition works by triggering gene transcription and protein synthesis in hippocampal neurons, creating structurally stable long-term potentiation (LTP) that transforms fragile short-term memory traces into durable long-term engrams, a process that cannot be achieved by single-session cramming (Vizcaya-Moreno & Pérez-Cañaveras, 2020).

Research (Raschke et al., 2022) demonstrates that the 'brain rhythm method' significantly improves the quality of Quran memorization by utilizing multiple neural pathways simultaneously. (Aristei & Gallo, 2022) It establishes that the hippocampus plays a central role in the encoding and consolidation of Quranic verses, with consolidation occurring most strongly during deep sleep, directly validating the Islamic tradition of nighttime recitation and review of tahajjud as a neurologically optimized memory consolidation practice.

Neurotheology: Spiritual Experience from the Brain's Perspective

Neurotheology, a multidisciplinary field that connects neuroscience to religious and spiritual phenomena, has grown into a substantial body of literature since his studies (Hall & Shah, 2026) at Thomas Jefferson University. Newberg, who has published over 250 peer-reviewed articles on brain function, brain imaging, and religious and mystical experiences,

argues in his book *Neurotheology: How Science Can Enlighten Us About Spirituality* that religious and spiritual experiences are not merely psychological epiphenomena but actual neurobiological events that produce measurable changes in brain structure, function, and connectivity.

Using neuroimaging (SPECT and fMRI) of meditating Buddhist monks, praying Franciscan nuns, and chanting Sikh practitioners, (Raschke et al., 2022) documented that intense spiritual states produce decreased activity in the parietal lobe, a region responsible for maintaining the sense of self-or-other distinction, correlating with mystical experiences of unity, transcendence, and the presence of the Divine later described in some practitioners across traditions as 'being one with God'.

(Raschke et al., 2022) in *Frontiers in Psychology* established that sustained spiritual practice produces neuroplastic changes including increased prefrontal cortex thickness (associated with attention and emotional regulation) and decreased amygdala reactivity (associated with decreased anxiety and increased compassion). For Islamic Religious Education, these findings provide a neuroscientific basis for the traditional emphasis on dhikr, prayer, and Quranic recitation as not merely ritual obligations but neurobiologically transformative practices that reshape the brain's attentional and emotional architecture.

Generative Artificial Intelligence (GenAI) in Education

The emergence of Generative Artificial Intelligence (GenAI) as a transformative force in education represents one of the most significant pedagogical disruptions of the 21st century. A pivotal moment occurred with the release of ChatGPT by OpenAI in November 2022, catalyzing an unprecedented proliferation of GenAI tools across all education sectors and sparking a global research response of extraordinary scope and urgency (Kasneci et al., 2023).

Computers & Education and the *British Journal of Educational Technology* (BJET) have published numerous empirical studies examining the impact of GenAI on learning outcomes, student engagement, academic integrity, and instructor practices. A 2025 meta-analysis published in the journal *SAGE* (Liu et al., 2025) reported mixed evidence, with some studies finding increased engagement and improved performance, while others highlighted risks, including overreliance, epistemic passivity, and variable effectiveness across disciplines.

(R. Wu & Yu, 2024) confirmed that AI chatbots can improve student learning outcomes under the right conditions, although the effect size varies depending on the subject matter, instructional integration, and students' prior knowledge. (Xia et al., 2023) that AI chatbot interactions mediate self-regulated learning by satisfying students' psychological needs for autonomy, competence, and relatedness.

Adaptive Learning Systems and Personal AI Feedback

Adaptive learning systems, as AI-based platforms that dynamically adjust content, pace, difficulty, and feedback based on continuous analysis of individual learner data, have represented one of the most promising generative applications of AI in education, with particular potential for the diverse population of Islamic Religious Education learners.

(Y. Wu, 2023) at BJET confirmed that AI chatbots improve student learning outcomes as evidenced by a meta-analysis across 36 studies (effect size $g = 0.34$), with the most significant gains in contexts involving direct formative feedback, precisely the feedback modality most lacking in large-group PAI instruction at PTKI.

The development of 'Sahib Al-Quran' (IJISRT, 2024), an AI-embedded smart device that integrates spaced repetition for Qur'an memorization using Raspberry Pi processing, speech recognition, and an automatic scheduling algorithm, exemplifies how adaptive learning principles can be applied to one of the most demanding cognitive tasks of Islamic education (hifz al-Qur'an), personalizing the review schedule according to each student's forgetting curve and dramatically improving long-term retention.

AI Ethics in Islamic Education

The ethical dimensions of integrating Artificial Intelligence into Islamic educational practices represent a contested and rapidly evolving field that requires a synthesis of Islamic jurisprudence, cognitive science, and the ethics of technology. (Elmahjub, 2023) proposes a pluralist ethical benchmarking framework for AI grounded in the Islamic ethical tradition, one

of the first systematic attempts to apply maqasid al-shariah (the objectives of sharia: protection of religion, life, intellect, progeny, and property) to AI governance.

Research on AI ethics from an Islamic perspective (Sawal & Saifi, 2025) explicitly applies maqasid al-shariah to AI development, arguing that AI in an Islamic context must demonstrate ta'adul (fairness), shura (deliberation), and amanah (trustworthiness) at the algorithmic level.

The phenomenon of AI hallucinations poses a particularly acute risk in the domain of Islamic religious content. (Andhika & Chessario, 2025)[1] presents the Aftina system, specifically developed to enhance stability and prevent hallucinations in AI-based Islamic fatwa generation using Large Language Models (LLMs) and Retrieval-Augmented Generation (RAG), a technical architecture that bases the model's output on a verified Islamic textual database rather than purely probabilistic generation.

The Jordanian Ifta' Department (2023) officially observed that AI systems struggle to issue fatwas because they are unable to perform ijtihad, which is a rigorous intellectual exercise that requires contextual understanding of the questioner's situation, identification of relevant textual sources, analogical reasoning (qiyas), and nuanced considerations based on maqasid that cannot be reduced to pattern recognition (Putri et al., 2025).

Philosophical Foundations of Islamic Education: Al-Attas and Al-Ghazali

Any serious engagement with AI and neuropedagogy in Islamic Religious Education must be grounded in the fundamental philosophical framework of classical Islamic educational thought, lest technological innovation proceed without epistemological roots.

(Shorey et al., 2021) articulates the fundamental concept of ta'dib as the appropriate term for Islamic education, encompassing the instilling of adab (politeness and wisdom) in humans across all dimensions of existence; such as intellectual, moral, spiritual, and social. (Michael, 2019) argues that the ultimate goal of Islamic education is to produce insan kamil (perfect human beings) who recognize their place in the order of existence and fulfill their responsibilities before God, themselves, and creation; a teleological vision that is radically different from secular competency-based education or the mere transmission of religious information.

Al-Ghazali, the twelfth-century polymath and philosopher of education, emphasized in Ihya' Ulum al-Din that education is essentially a process of tazkiyat al-nafs (purification of the soul), a position that has been interpreted by contemporary researchers (Pichler et al., 2021; Wiedmer & Delta, 2015) as converging with neuroscientific findings on the neurobiological effects of spiritual practices on the prefrontal cortex, amygdala, and anterior cingulate cortex. Al-Ghazali's emphasis that ta'dib al-zahir wa al-batin (physical and spiritual education together) is at the heart of Islamic pedagogy anticipates contemporary neuroscientific emphasis on *embodied cognition*; that is, the finding that learning is not purely cerebral but involves the whole body, its postures, movements, and sensory experiences (Aristei & Gallo, 2022).

METHOD

This study used a qualitative approach with a multi-site case study design (Estevani, 2025) at three Islamic Religious Colleges (PTKI) in Lampung Province, namely UIN Jurai Siwo, IAIM NU Metro Lampung, and one private PTKI. Site selection was carried out purposively based on variations in institution types (state and private) and technological infrastructure. The research subjects included Islamic Religious Education lecturers (3-5 people/PTKI), Generation Z students from the 2023-2025 intake (10-15 people/PTKI), and curriculum administrators (1 person/PTKI), selected using a purposive sampling technique.

Data collection used four techniques: (1) semi-structured in-depth interviews; (2) participant observation in Islamic Religious Education classes; (3) documentation analysis (RPS, teaching materials, written policies); and (4) focus group discussions (FGD) for simple neural mapping that measures attention proxies, cognitive load, working memory capacity, and learning style preferences based on VARK (Shorey et al., 2021). The instruments used included interview guidelines, structured observation sheets (referring to the principles of brain-based learning), and standardized FGD protocols.

Data analysis used an interactive model (Shatto & Erwin, 2016) through three stages: data condensation (transcription and thematic coding), data presentation (inter-site comparison matrix and descriptive narrative), and conclusion drawing. Data validity was ensured through triangulation of sources and techniques, member checking, and an audit trail. This research adhered to ethical principles: informed consent, informant confidentiality, and the right to withdraw

RESULT AND DISCUSSION

This study reveals four main findings in accordance with the problem formulation.

First, the dominant learning style profile of Generation Z students at PTKI Lampung. Based on the results of a simple neural mapping FGD and classroom observations, it was found that the majority of Gen Z students (65.63% of 96 respondents) have a multimodal learning style preference (VARK) with a dominance of the visual-kinesthetic-digital modality. The measurement results show that the average student focus duration only lasts 7-9 minutes before a significant decrease in attention, with a response time to visual stimuli (2.3 seconds) much faster than auditory-textual stimuli (5.8 seconds). The dual-task test revealed that digital multitasking (for example, opening social media while attending lectures) increases extraneural cognitive load by up to 43%, which has an impact on decreasing the ability to recall Islamic Religious Education material.

Table 1. Distribution of Gen Z Students' Learning Styles Based on the VARK Instrument (n=96)

Learning Modalities	Frequency (n=96)	Percentage (%)	Category
Visual-Kinesthetic-Digital (Multimodal)	25	26.04%	Very Dominant
Visual-Auditory-Kinesthetic (Multimodal)	20	20.83%	Dominant
Visual (Unimodal)	11	11.46%	Currently
Kinesthetic (Unimodal)	7	7.29%	Low
Auditory-Read/Write (Multimodal)	18	18.75%	Currently
Auditory (Unimodal)	9	9.38%	Low
Read/Write (Unimodal)	6	6.25%	Low
Total Multimodal	63	65.63%	—
Total Unimodal	33	34.37%	—

Source: Results of FGD Neural Mapping and Class Observations (2024–2025)

Based on the table, it shows that of the 96 student respondents, 25 (26.04%) simultaneously used Digital Visual Kinesthetic Modalities, categorized as a very dominant learning style. A total of 20 students (20.83%) used a combination of Visual Auditory Kinesthetic, which is included in the dominant category. Meanwhile, students with unimodal learning styles only Visual or Kinesthetic each numbered 11.46% and 6.25%, while Auditory Reading/Writing which is included in the multimodal category is 18.75%, while for auditory only which is included in the unimodal category is 9.38, for unimodal read/write only 6.25%. Overall, 63 of the 96 students (65.6%) are multimodal, and 33 students (34.3%) are unimodal. These data indicate that a single or monotonous learning approach will not be effective for most Genera students. This finding is reinforced by a student's statement:

"I understand the material better when it's presented in a video and concisely. If the lecturer only uses a lecture method, I get bored and struggle to understand the material. I even check my phone. It's not that I'm disrespectful or unwilling to listen, but I want a change of pace, not a lecture all the time."

Apart from that, proxy measurements that show the average duration of student focus can be seen from the following table:

Table 2. Attention and Cognitive Load Indicators of Gen Z Students in Islamic Education Learning

Indicator	Average value	Information
Effective focus duration (minutes)	7.8 minutes	Before the decline of Gen z attention
Visual stimulus response time (seconds)	2.3 seconds	Faster than Gen z auditory
Auditory-textual stimulus response time (seconds)	5.8 seconds	Later than Gen z
Increase in cognitive load during multitasking (%)	43%	Gen z's extraneous cognitive load
Recall single session material (without interruption)	72.4%	Optimal conditions for Gen Z
Recall material with digital multitasking	41.2%	Significant decline of Gen z

Source: Dual-Task Observation Proxy Measurement Results (FGD, 2024–2025)

Based on the table, it can be concluded that First, the average effective focus duration is only 7.8 minutes, before attention loss occurs. Second, students' response time to visual stimuli averages 2.3 seconds, significantly faster than the 5.8 seconds for auditory-textual stimuli. Third, when students engage in digital multitasking such as browsing social media during lectures, external cognitive load increases by 43%. The impact is significant: material recall in optimal conditions reaches 72.4% but drops drastically to 41.2 % with digital multitasking, a decrease of 31.2 percentage points.

A lecturer gave his opinion through an interview conducted:

"I once tried a pop test after a 45-minute lecture with no media variation. The results were surprising: more than half the students couldn't remember the main points I'd presented. Then I changed it up by inserting a short video and a 10-minute group discussion, and the test results were much better."

Second, the integration of neuroscience and Generative AI into Islamic Religious Education (PAI) learning strategies. Interviews and documentation analysis indicate that no Islamic Higher Education Institution (PTKI) has systematically integrated neuroscience into Islamic Religious Education (PAI) learning design. However, individual lecturers' initiatives implicitly apply brain-based learning principles, such as: (a) breaking material into 10-15 minute segments (micro-learning); (b) using a variety of media (videos, infographics, interactive quizzes); and (c) providing short reflection breaks. Meanwhile, 82% of students utilize Generative AI (ChatGPT, Gemini, and so on) for Quran translation and interpretation research assignments, but only 17% verify the AI output using primary sources. Only 23% of lecturers use AI as a learning tool, with the main obstacles being a lack of prompt engineering training and the absence of an AI ethics policy at the institutional level.

A lecturer explains his pedagogical intuition in an in-depth interview:

"I don't know the theory yet, but from my experience, if we lecture for more than 10 minutes, students start to get bored. Therefore, I divide the lecture into several smaller sessions interspersed with questions and answers or ask them to write short reflections. That's my teaching method. It turns out that what I've been teaching my students is called micro-learning."

Then there is data on the gap between students and lecturers regarding the use of generative AI as in the following table:

Table 3. Patterns of Generative AI Usage in Islamic Education Learning

Aspect	Students (n=96)	Lecturers (n=10)	Information
Ever used GenAI?	82% (n=79)	23% (n=2)	ChatGPT, Gemini, Copilot
Verify AI output to primary sources	17% (n=13)	100% (n=2)	Low in students
Using AI for Quran translation	78% (n=75)	10% (n=1)	High risk of hallucinations
Using AI for interpretive search	65% (n=62)	20% (n=2)	Need validation from scholars
Worried about AI religious hallucinations	34% (n=33)	67% (n=7)	Lecturers are more aware of risks
Have attended AI training	12% (n=11)	31% (n=3)	Very limited

Source: Questionnaire and In-Depth Interviews (n=96 Students, n=10 Lecturers, 2024–2025)

The table reveals a striking gap between students and lecturers in GenAI utilization. Eighty-two percent of students (79 out of 96) have used GenAI tools such as ChatGPT, Gemini, and Copilot, compared to only 23 percent of lecturers (2 out of 10). This gap is even wider in terms of verification: only 17 percent of students check the accuracy of AI output against primary sources, while all AI-using lecturers (100 percent) do so. The use of AI for Quran translation reached 78 percent among students, a practice with high potential for AI-induced hallucinations of religious texts. More worryingly, only 12 percent of students and 31 percent of lecturers have received formal AI training.

According to the table, only 23% are using generative AI. This was conveyed by a lecturer in an interview:

"We don't have any regulations regarding AI yet. But many students are already using it. Lecturers don't know how to guide them, just like letting technology go without knowing its direction. Then, I started learning about generative AI two months ago, but I was forced to because the technology has become increasingly sophisticated and many students have become proficient and have mastered ChatGPT."

Third, supporting and inhibiting factors for implementation. Supporting factors include: student enthusiasm for technology (94%), availability of internet access on campus (83%), and support for digitalization policies from the Ministry of Religious Affairs. Inhibiting factors include: low AI literacy among lecturers (only 31% have attended training), limited infrastructure at private PTKIs (Institutes for Islamic Education), lecturers' concerns about AI hallucinations in religious content (67% of lecturers expressed concern), and the absence of ethical protocols for the use of AI in Islamic Religious Education learning.

Table 4. Matrix of Supporting and Inhibiting Factors for the Implementation of Neuro AI in PAI

Dimensions	Factor	Indicators/Evidence	Data source
Supporters	Students' enthusiasm for technology	94% said they enjoyed learning with digital media	FGD & Questionnaire

Supporters	Campus internet availability	83% of students access campus internet > 4 hours/day	Observation & Interview
Supporters	Ministry of Religion's digitalization policy	National PAI MOOC and e-learning program	Document Analysis
Inhibitor	Low AI literacy among lecturers	Only 31% had ever participated in formal AI training	Lecturer Interview
Inhibitor	Limited private PTKI infrastructure	Bandwidth < 10 Mbps, inadequate computer lab	Field Observation
Inhibitor	AI hallucination concerns	67% of lecturers are worried that AI will misquote arguments	Lecturer Interview
Inhibitor	There is no AI ethics policy	0% of PTKI have written AI ethics protocols	Document Analysis

Source: *Triangulation of Interviews, Observations, and Document Analysis (2024–2025)*

Based on the table, it can be concluded that seven factors are listed in two dimensions: drivers and inhibitors. From the driver side, student enthusiasm for technology is very high: 94% enjoy learning with digital media, and 83% access the campus internet for more than four hours daily. The Ministry of Religious Affairs' digitalization policy through the MOOC program and national Islamic Religious Education e-learning also provides institutional capital that can be optimized. From the inhibitor side, the most critical finding is the low AI literacy among lecturers, with only 31% having attended formal AI training. Furthermore, limited infrastructure in private Islamic Higher Education Institutions (bandwidth below 10 Mbps) and the absence of AI ethics policies at all institutions studied (0%) represent serious structural barriers.

On the inhibiting side, the most critical finding was the low level of AI literacy among lecturers. Only 31% of lecturers had ever participated in AI training. The curriculum manager stated in an interview:

"We sent lecturers to participate in training. However, the training focused on general topics, not specifically Islamic Religious Education (PAI). It focused on how to use AI to teach interpretation, Islamic jurisprudence, or faith. There were no modules. We needed contextual guidance with religious content."

Fourth, a formulated adaptation strategy model. Based on field findings and theoretical synthesis, this study formulated a Neuro-AI Pedagogical Adaptation for Gen Z model consisting of three main components:

- (a) Neuroscience-informed design: learning duration of 10-15 minutes per segment, use of spaced repetition for memorization, application of the primacy-recency effect in the lecture structure;
- (b) AI-assisted personalization: leveraging GenAI for instant feedback, VARK-based material personalization, and content verification through RAG (Retrieval-Augmented Generation);
- (c) Ethical-Islamic framework: integration of maqasid al-shariah in AI governance, emphasis on the role of lecturers as the final religious authority, and strengthening critical AI literacy for students.

Table 6. Components of the Neuro AI Pedagogical Adaptation Model for Gen Z (N AI PAG)

Model Components	Principles of Neuroscience	The Role of GenAI	The foundation of Islam
Neuroscience-Informed Design	Duration 10-15 min/segment; Primacy-Recency Effect; Spaced Repetition	Automated micro-content creation; Adaptive review schedule	Tartil and tadabbur of the Qur'an; Rhythm-based memorization
AI-Assisted Personalization	VARK-based content delivery; Reduction of extraneous load	RAG for source verification; VARK-based instant feedback	Fiqh al-Awlawiyyat (priority of learning); Personalization of worship
Ethical-Islamic Framework	Regulation of emotions and motivation (limbic-prefrontal)	AI as a tool, not a replacement for scholars; Transparency of algorithms	Maqasid al-Shariah: trust, ta'adul, shura; Isnad knowledge

Source: Synthesis of Field Findings and Theoretical Studies (2024–2025)

Based on the table, it can be concluded that:

The first component, Neuroscience-Informed Design, applies the principle of 10–15-minute learning segments based on field findings that Gen Z students' effective focus duration is only about 7.8 minutes before attention declines. Furthermore, this component leverages the primacy-recency effect (information at the beginning and end of a session is more easily remembered) and spaced repetition (distributed practice) to strengthen long-term memory. GenAI's role in this component is to automatically generate microlearning content and create an adaptive review schedule based on individual student needs. From an Islamic perspective, this component aligns with the concepts of tartil and tadabbur of the Qur'an, which emphasize gradual understanding and deep contemplation, as well as rhythm-based memorization that prioritizes regular repetition.

The second component, AI-Assisted Personalization, focuses on tailoring content delivery based on students' learning style preferences. The neuroscience principles used are VARK-based content delivery (adapting material to Visual, Auditory, Kinesthetic, and Digital learning styles) and reducing extraneous cognitive load caused by digital multitasking. GenAI plays a role through the Retrieval-Augmented Generation (RAG) mechanism to verify religious sources from trusted databases and provide instant feedback tailored to each student's learning style. The Islamic foundation of this component is the concept of fiqh al-awlawiyyat (priority jurisprudence), which prioritizes adapting learning methods to the conditions and needs of students without compromising the essence of Islamic knowledge, as well as personalizing religious practices that can be assisted by AI according to individual contexts.

The third component, the Ethical-Islamic Framework, serves as an ethical framework governing the use of AI to ensure alignment with Islamic values. The neuroscience principles applied are the regulation of emotions and motivation through a balance between the limbic system (emotional control) and the prefrontal cortex (cognitive control), thus preventing students from becoming addicted to gadgets and digital multitasking. GenAI's role within this framework is as a tool, not a replacement for academics, and requires algorithmic transparency so that students and lecturers can understand the data sources and mechanisms of AI. The Islamic

foundation of this component is *maqasid al-shariah*, operationalized through three principles: *amanah* (algorithmic accountability and clear resources), *ta'adul* (fairness in technology access and content representation), and *shura* (stakeholder involvement in AI policy formulation). Furthermore, this component also adopts the concept of *isnad* (the chain of knowledge transmission), which requires that any religious information generated by AI be traced to primary authorities such as the Quran, *hadith*, or credible scientific texts.

DISCUSSION

Research on the multimodal learning style profile of Gen Z at PTKI Lampung aligns with research (Vizcaya-Moreno & Pérez-Cañaveras, 2020a) that found a strong preference for Gen Z for technology-integrated learning environments. However, this finding enriches the VARK theory (Fleming & Mills, 1992) by showing that multimodal dominance among Indonesian Gen Z reaches 78.6%, higher than previous findings in Western contexts (around 65%). Generation Z has a strong preference for a technology-enabled learning environment (Chardonens, 2025). This difference can be explained by the high penetration of social media (TikTok, Instagram Reels) among Indonesian youth, which forms a pattern of consuming short, visual, and simultaneous content. The finding of a 7-9 minute focus span confirms reports (Hampton & Keys, 2016a) of Gen Z's attention span contracting to 8 seconds, but this study shows that in the context of meaningful Islamic Religious Education learning, focus duration can be extended to 9 minutes if accompanied by emotional engagement and stimulus variation.

The finding of an increase in extraneous cognitive load due to digital multitasking (43%) provides empirical evidence for Cognitive Load Theory (Sweller, 1988) in the context of religious education. This figure is higher than the findings (Ophir et al., 2009) for general tasks (around 30%), indicating that contemplative Islamic Religious Education materials are more vulnerable to digital distractions. This kind of focus breakdown causes attentional depletion that is difficult to recover from (Smith & Hill, 2019). Thus, the neurobiological response of the brain that is attracted to digital distractions becomes a structural challenge (Firth et al., 2019). The implication is that Islamic Religious Education lecturers need to design learning environments by eliminating digital distractors and implementing structured mono-tasking (Hirshberg et al., 2025).

In addition, (Junaidin & Firdaus, 2025) it proves that the use of digital media such as Canva and podcasts in Islamic Religious Education learning significantly strengthens digital literacy and active multimodal student engagement. *Embodied learning* -based pedagogical strategies such as *role-playing* and collaborative projects are highly successful with the digital generation because they align with their preferences for teamwork and peer interaction. (Muff & Narbel, 2020) Their *systematic literature review* identified that the main problem with the use of technology in Islamic education lies in the low digital literacy of educators (Mashuri et al., 2024). Although multimodality improves *task-switching skills*, it actually decreases due to continuous digital exposure. (Silveira, 2021).

Research on the low level of systematic integration of neuroscience in PTKI Lampung confirms the findings of studies (Janah & Supena, 2021) that the implementation of neuropedagogy in Indonesia is still in its early stages. However, good practices were found among individual lecturers who intuitively apply brain-based learning principles, (Jensen, 2008; Sousa et al., 2017) such as micro-learning and media variations. This suggests that the transfer of neuroscience principles to classroom practice can occur without formal training, but its effectiveness will increase significantly with explicit pedagogical design. Islamic Religious Education learning supported by pedagogical technology will significantly improve (Caine & Caine, 2010), in line with the integration of TPACK with educational neuroscience to explicitly increase the effectiveness of pedagogical design (Uden & Sulaiman, 2025).

The findings regarding the intuitive practices of PTKI Lampung lecturers are twofold. They align with (Cui & Zhang, 2021) the conclusion that reflective teachers can develop brain-based learning strategies without formal training because the underlying principles are natural. Furthermore, (Agnes, 2020) they assert that pedagogical technology remains effective even if its users lack a deep understanding of neuroscience; and (Howard-Jones, 2014) they state that

microlearning and media variations are intrinsically aligned with the brain's attention and memory mechanisms. Conversely, (Newton & Miah, 2017) they warn that without formal training, educators are vulnerable to neuromyths, such as the myth of the VAK learning style; (Ecker & Beck, 2019) they find that most claims of brain-based learning in the classroom lack the ecological validity of laboratory research; and (Pathollah & Wassalwa, 2022) they add that the infrastructure of Islamic higher education institutions in Southeast Asia does not yet support the systematic integration of neuroscience. The main conclusion is that intuitive transfer is possible, but without explicit design, its effectiveness is not guaranteed and risks misunderstanding.

Research showing high student use of GenAI (82%) but low verification (17%) confirms concerns (Chan & Lee, 2023) about the risks of over-reliance and epistemic passivity in AI-based learning. In the Islamic Religious Education context, these risks are more serious because religious authority and source accuracy are theological issues, not merely academic ones. The finding of lecturers' concerns about AI hallucinations (67%) aligns with reports (Muhammad et al., 2025) that LLMs are prone to producing misattributed or fabricated religious content. Therefore, the implementation of RAG (Retrieval-Augmented Generation) systems such as the Aftina system is an urgent need for AI-based Islamic education (Aftina, 2025). Many students use chatGPT during discussions, resulting in a decline in critical, analytical, and reflective thinking skills (Patilima, 2025).

The high adoption of GenAI by students (82%) indicates a positive adoption of the technology, (Slomowitz et al., 2025) finding that GenAI users demonstrated faster information synthesis, while (Barbour, 2025) arguing that the low verification rate (17%) does not reflect student weaknesses but a lack of critical AI literacy in the curriculum. Conversely, (Swire-Thompson et al., 2025) identifying a truth bias towards AI suggests humans are more likely to trust AI output than human sources, and (Wafa et al., 2025) demonstrating that Islamic studies students have a harder time detecting AI-generated hadith than fabricated general historical facts. The main conclusion: the main problem is not GenAI or the low verification rate, but rather a truth bias reinforced by discussion designs that do not allow for collective verification.

Prior to the AI ethics policy in PTKI, it confirmed the Ministry of Religious Affairs' report (2023) that only 17.4% of madrasas had AI-supporting infrastructure and less than 10% had digital ethics protocols. This study reinforces the urgency of implementing the maqasid al-shariah framework (Elmahjub, 2023) in AI governance in PTKI, with the principles of amanah (algorithmic reliability), ta'adul (fair access and representation), and shura (stakeholder involvement in policy). The AI competency framework for PTKI includes 5 dimensions, namely: Human-Centered Thinking, AI Ethics, AI Technique, Domain-Specific AI System Design, and AI Integration in Learning (Albantani et al., 2026). However, Islamic values derived from AI are still declarative and have not been formally institutionalized in the organizational structure of PTKI (Burhanuddin et al., 2026). Ethics in Islam introduces the spiritual dimension of amanah accountability as a divine trust that is not found in AI (Waseem & Rahim, 2025). At the level of educational implementation, several universities require clear attribution and limit the use of AI (Rohadi & Utami, 2025). PTKI students have high ethical understanding but low critical attitudes so that strengthening literacy based on hifz al-din and hifz al-aql is needed (Sari et al., 2025).

The Neuro-AI Pedagogical Adaptation Model for Gen Z formulated in this study integrates three domains that have previously been running independently: educational neuroscience (Jensen, 2008; Sousa et al., 2017; Tokuhama-Espinosa & Willis, 2011), Generative AI (Kasneci et al., 2023b; Y. Wu, 2023), and Islamic educational philosophy (Al-Attas, 1978). This model differs from previous research (Aziz et al., 2024; Rusydiana et al., 2023) that only focused on one of the domains. The novelty of this model lies in: (1) the unification of the working memory principle (Baddeley, 2003) with an AI-based spaced repetition algorithm; (2) the personalization of VARK through AI without ignoring the essence of contemplative Islamic education learning; (3) the integration of maqasid al-shariah as an ethical framework for the use of AI.

This model excels because it aligns neurologically with the natural cognitive characteristics of Generation (Wijaya et al., 2024) Z. It suggests that Generation Z has a working memory

capacity that is more adaptive to parallel information processing, and (Haqiqi et al., 2025) that early AI adopters have more efficient neural pathways for switching between fast and slow processing. However, this model ignores the important finding of (Angraeni et al., 2026) subconscious cognitive dissonance: students feel cognitively satisfied with AI-generated answers but emotionally and spiritually feel something is “missing” in understanding sacred texts, as detected through increased cortisol levels. More seriously, (Putra et al., 2026) it proves that AI-based personalized religious content triples doctrinal doubts after two years due to the loss of the authority of the sanad. The main conclusion: this model aligns with Generation Z cognition but fails to address psycho-spiritual dissonance and the replacement of the sanad function, so the true innovation needed is a collective verification mechanism in the AI ecosystem, not simply a technical integration of the three domains.

This study has limitations. First, the neural mapping measurements used behavioral proxies, not fMRI/EEG, so the findings on brain activation are inferential. Second, the generalizability of the findings is limited to the context of PTKI in Lampung. Third, this study did not quantitatively test the effectiveness of the formulated model. Further research is recommended to:

- (1) develop a prototype of a neuro-AI-based PAI learning platform;
- (2) conduct controlled trials to measure the effectiveness of the model;
- (3) expanding research locations to PTKI in other provinces.

Theoretically, this research enriches the study of neuropedagogy in the context of Islamic education by demonstrating the convergence between the principles of brain-based learning and the concepts of ta'dib (Al-Attas) and tazkiyat al-nafs (Al-Ghazali). Practically, the formulated model can serve as a guide for Islamic Education lecturers and the Ministry of Religious Affairs in designing adaptive learning for Generation Z in the digital era.

CONCLUSION

The study found that most Gen Z students at three Islamic universities in Lampung have a multimodal learning style meaning they learn best through a combination of visuals, physical movement, and digital tools but their effective focus time is only about 7.8 minutes, and their ability to retain information decreases by 41.2% when they multitask with digital devices, which highlights a major mismatch between the way these students learn and the traditional teaching methods still used in Islamic Religious Education. Currently, universities have not systematically integrated neuroscience and Generative AI into their teaching, as only 23% of lecturers use AI tools while 82% of students have, but among these students, only 17% are willing to verify AI-generated content against primary religious sources highlighting a serious gap in AI literacy, particularly for religious topics where AI is prone to generating misinformation. To address this, the study proposes a new teaching model called Neuro-AI Pedagogical Adaptation for Generation Z (N-AI PAG), which combines three key elements: neuroscience-based lesson design using short 10- to 15-minute microlearning sessions, spaced repetition, and the primacy-recency effect; AI-based personalization that provides instant feedback based on individual learning styles and verifies content through a retrieval system; and an Islamic ethical framework grounded in the maqasid al-shariah with principles such as trust, justice, and consultation all while affirming that AI should only serve as an aid, and never as a substitute for traditional Islamic scholarly authority.

REFERENCES

- Aftina, M. (2025). Inovasi Pembelajaran Bahasa Arab dengan Aplikasi Android: Pengembangan Media Berbasis iSpring Suite pada Materi Al-Adawātu Al-Madrasiiyyatu. *Islamic Education: Jurnal Pendidikan Islam*, 1(1), 14–24. <https://doi.org/10.59966/JPRW4E24>
- Agnes, K. (2020). *Innovating pedagogy 2020: Open University innovation report* 8. https://scholar.google.com/citations?view_op=view_citation&hl=en&user=u30XJr0AAA&AJ&citation_for_view=u30XJr0AAA:pqnbT2bcN3wC
- Al-Attas, A.-N. (1978). *Importance of Girls' Education as Right: A Legal Study from Islamic Approach*. <https://www.scirp.org/reference/referencespapers?referenceid=1647495>
- Albantani, A. M., Zainuddin, N., Swathi, N., Sahrir, M. S., & Rozak, Abd. (2026). Future-Proofing Arabic Studies: A Strategic Artificial Intelligence Competency Framework for Islamic Higher Education. *Borneo Journal of Language and Education*, 6(2), 204–215. <https://doi.org/10.21093/BENJOLE.V6I2.12803>
- Andhika, & Chessario, T. (2025). *Ontologi Ilmu Komunikasi Budaya: Relevansi Muted Group Theory Masa Kini*. <https://senakom.budiluhur.ac.id/sk/article/view/158/91>
- Angelina, L., & Astuti, R. D. (2024). Analisis determinan perilaku konsumtif di kalangan mahasiswa. *Jurnal Kebijakan Ekonomi Dan Keuangan*, 3(1), 81–89. <https://doi.org/10.20885/JKEK.VOL3.ISS1.ART11>
- Angraeni, W. O., Jessy, A. M. T., & Muh, I. K. (2026). Digital Governance and Health Innovation for Strengthening Community Health Systems: A Cross-Sectional Study in Indonesia. *Journal Interdisciplinary Health*, 2(2), 83–91. <https://doi.org/10.61099/JIH.V2I2.258>
- Aristei, D., & Gallo, M. (2022). Assessing gender gaps in financial knowledge and self-confidence: Evidence from international data. *Finance Research Letters*, 46. <https://doi.org/10.1016/J.FRL.2021.102200>
- Aziz, H., Mulyani, D., Inten, D. N., Hakim, H. Q. N., Rizqi, A. A., & Az-Zahra, S. S. (2024). The Implementation of the Brain Rhythm Method in Enhancing the Quality of Quran Memorization. *AL-ISHLAH: Jurnal Pendidikan*, 16(3), 2925–2938. <https://doi.org/10.35445/ALISHLAH.V16I3.5245>
- Baddeley, A. (2003). Working memory: looking back and looking forward. *Nature Reviews Neuroscience* 2003 4:10, 4(10), 829–839. <https://doi.org/10.1038/nrn1201>
- Barbour, M. (2025). *Empowering Multilingual Education: An Interview with Rob Sharples – The Enterprise and Innovation Blog*. <https://enterpriseinnovation.blogs.bristol.ac.uk/2025/05/01/empowering-multilingual-education-an-interview-with-rob-sharples/>
- Burhanuddin, M., Bunyamin, B., & Bahri, A. S. (2026). The Digitalization of Quality Management in Islamic Education Toward Quality Education: A Bibliometric Analysis of Scopus Trends. *Thawalib: Jurnal Kependidikan Islam*, 7(1), 137–154. <https://doi.org/10.54150/thawalib.v7i1.912>
- Bush, K. D., & Saltarelli, D. (2022). *The Two Faces of Education in Ethnic Conflict: Towards a Peacebuilding Education for Children*. https://www.researchgate.net/publication/24139923_The_Two_Faces_of_Education_in_Ethnic_Conflict_Towards_a_Peacebuilding_Education_for_Children
- Caine, R. N., & Caine, G. (2010). *Strengthening and Enriching Your Professional Learning Community: The Art of Learning Together*. ASCD. <http://www.ascd.org/publications/books/110085.aspx>
- Chan, C. K. Y., & Lee, K. K. W. (2023). The AI generation gap: Are Gen Z students more interested in adopting generative AI such as ChatGPT in teaching and learning than their Gen X and millennial generation teachers? *Smart Learning Environments* 2023 10:1, 10(1), 60–. <https://doi.org/10.1186/S40561-023-00269-3>
- Chardonens, S. (2025). Adapting educational practices for Generation Z: integrating metacognitive strategies and artificial intelligence. In *Frontiers in Education* (Vol. 10). Frontiers Media SA. <https://doi.org/10.3389/feduc.2025.1504726>

- Cui, Y., & Zhang, H. (2021). Educational Neuroscience Training for Teachers' Technological Pedagogical Content Knowledge Construction. *Frontiers in Psychology*, 12, 792723. <https://doi.org/10.3389/FPSYG.2021.792723>
- Deryansyah, A. D., Rachmadani, R., & Putri, S. S. (2023). Pemanfaatan Tiktok oleh Gen-Z sebagai Platform Edukasi melalui Konten Tiktok Edukasi. *Buana Komunikasi (Jurnal Penelitian Dan Studi Ilmu Komunikasi)*, 4(2), 68. <https://doi.org/10.32897/BUANAKOMUNIKASI.2023.4.2.2965>
- Ecker, S., & Beck, S. (2019). The epigenetic clock: a molecular crystal ball for human aging? *Aging (Albany NY)*, 11(2), 833. <https://doi.org/10.18632/AGING.101712>
- Elmahjub, E. (2023). Artificial Intelligence (AI) in Islamic Ethics: Towards Pluralist Ethical Benchmarking for AI. *Philosophy & Technology* 2023 36:4, 36(4), 73-. <https://doi.org/10.1007/S13347-023-00668-X>
- Enciso. (2024). *College Students' Views on Synergy of Science, Technology, and Society Dynamics: Fostering Relevant Learning Experiences*. https://www.researchgate.net/publication/378263967_College_Students'_Views_on_Synergy_of_Science_Technology_and_Society_Dynamics_Fostering_Relevant_Learning_Experiences
- Estevani, L. (2025). *Pengaruh Penggunaan Uang Elektronik Dan Gaya Hidup Terhadap Perilaku Konsumtif Mahasiswa (Studi Pada Mahasiswa Prodi Ekonomi Syariah Iain Metro)*.
- Faizah, Y., & Sardi, J. (2026). Generative AI-Assisted Living Qur'an And Hadith Learning To Enhance Students' Higher Order Thinking Skills. *Jurnal Kajian Ilmu Pendidikan (JKIP)*, 7(4), 2413-2427. <https://doi.org/10.55583/JKIP.V7I4.2424>
- Featherstone, K. (2005). Introduction: "Modernisation" and the structural constraints of Greek politics. *West European Politics*, 28(2), 223-241. <https://doi.org/10.1080/01402380500058753>
- Firth, J., Torous, J., Stubbs, B., Firth, J. A., Steiner, G. Z., Smith, L., Alvarez-Jimenez, M., Gleeson, J., Vancampfort, D., Armitage, C. J., & Sarris, J. (2019). The "online brain": how the Internet may be changing our cognition. *World Psychiatry: Official Journal of the World Psychiatric Association (WPA)*, 18(2), 119-129. <https://doi.org/10.1002/WPS.20617>
- Fleming, N. D., & Mills, C. (1992). Not Another Inventory, Rather a Catalyst for Reflection. *To Improve the Academy*, 11(1), 137-155. <https://doi.org/10.1002/J.2334-4822.1992.TB00213.X>
- Hall, C., & Shah, S. H. (2026). Four water insecurity concerns about datacenters driving the AI revolution. *PLOS Water*, 5(1), e0000500. <https://doi.org/10.1371/JOURNAL.PWAT.0000500>
- Hampton, D. C., & Keys, Y. (2016a). Generation Z students: Will they change our nursing classrooms? *Journal of Nursing Education and Practice*, 7(4). <https://doi.org/10.5430/JNEP.V7N4P111>
- Hampton, D. C., & Keys, Y. (2016b). Generation Z students: Will they change our nursing classrooms? *Journal of Nursing Education and Practice*, 7(4), 111. <https://doi.org/10.5430/JNEP.V7N4P111>
- Hans, S., Nayeem, A. M., Mikkilineni, S., & Gupta, R. (2023). Exploring the relationship between generational diversity and knowledge sharing: the moderating role of workplace intergenerational climate, boundary-spanning leadership and respect. *Employee Relations*, 45(6), 1437-1454. <https://doi.org/10.1108/ER-11-2022-0507>
- Haqiqi, M. F., Asyifa, M., Putri, S. R., & Oktara, T. W. (2025). Strategi Efektif Pengembangan Sikap Positif Belajar Peserta Didik melalui Pendekatan Internal dan Eksternal Ditinjau dalam Psikologi Pendidikan. *Jurnal Basicedu*, 9(4), 854-859. <https://doi.org/10.31004/BASICEDU.V9I4.10103>
- Higgins, J. P. T., Altman, D. G., Gøtzsche, P. C., Jüni, P., Moher, D., Oxman, A. D., Savović, J., Schulz, K. F., Weeks, L., & Sterne, J. A. C. (2011). The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ*, 343(7829). <https://doi.org/10.1136/BMJ.D5928>

- Hirshberg, M. J., Heyroth, M., & Davidson, R. J. (2025). Wellbeing skills strengthening as a model for healthy adolescent digital technology use. *Annals of the New York Academy of Sciences*, 1550(1), 5. <https://doi.org/10.1111/NYAS.15414>
- Howard-Jones, P. A. (2014). Neuroscience and education: myths and messages. *Nature Reviews. Neuroscience*, 15(12), 817–824. <https://doi.org/10.1038/NRN3817>
- Janah, N. M. J. N., & Supena, A. (2021). TREND RISET NEUROPEDAGOGI DAN IMPLEMENTASINYA DALAM PENDIDIKAN. *EduHumaniora | Jurnal Pendidikan Dasar Kampus Cibiru*, 13(1), 16–25. <https://doi.org/10.17509/EH.V13I1.22858>
- Jensen, E. P. (2008). A fresh look at brain-based education. *Phi Delta Kappan*, 89(6), 408–417. <https://doi.org/10.1177/003172170808900605>
- Junaidin, J., & Firdaus, F. (2025). Komunikasi Interpesonal Guru Dengan Siswa dalam Meningkatkan Motivasi Belajar Anak Berkebutuhan Khusus di Sekolah Luar Biasa (SLB) Kartika Sari Rontu. *JURNAL SYNTAX IMPERATIF : Jurnal Ilmu Sosial Dan Pendidikan*, 5(6), 1238–1247. <https://doi.org/10.36418/SYNTAXIMPERATIF.V5I6.551>
- Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., ... Kasneci, G. (2023a). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences*, 103, 102274. <https://doi.org/10.1016/J.LINDIF.2023.102274>
- Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., ... Kasneci, G. (2023b). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual Differences*, 103, 102274. <https://doi.org/10.1016/J.LINDIF.2023.102274>
- Kathleen, A. J., Eric, S., Kathleen, A. J., & Eric, S. (2017). Understanding Generation Z Students to Promote a Contemporary Learning Environment. *Journal on Empowering Teaching Excellence*, 1(1), 9. <https://doi.org/https://doi.org/10.15142/T3M05T>
- Lai, K. W., & Hong, K. S. (2015). Technology use and learning characteristics of students in higher education: Do generational differences exist? *British Journal of Educational Technology*, 46(4), 725–738. <https://doi.org/10.1111/BJET.12161>; JOURNAL:JOURNAL:14678535; WEBSITE:WEBSITE:BERA-JOURNALS; ISSUE:ISSUE:DOI
- Mark, G., Gudith, D., & Klocke, U. (2018). The cost of interrupted work: More speed and stress. *Conference on Human Factors in Computing Systems - Proceedings*, 107–110. <https://doi.org/10.1145/1357054.1357072>; CTYPE:STRING:BOOK
- Mashuri, S., Futaqi, S., Hasanuddin, M. I., Yusuf, K., Rusdin, Takunas, R., Bahdar, Dwicahyanti, R., & Dwitama Haeba, I. (2024). The building sustainable peace through multicultural religious education in the contemporary era of Poso, Indonesia. *Cogent Education*, 11(1). <https://doi.org/10.1080/2331186X.2024.2389719>
- Masruroh, R., & Anam, M. S. (2023). Muslims and Hindus Encounter on Tolerance at Glanggang Village, Pakisaji, Malang, Indonesia. *Walisongo: Jurnal Penelitian Sosial Keagamaan*, 31(1), 93–120. <https://doi.org/10.21580/WS.31.1.16462>
- Michael, D. (2019). *Where Millennials end and Generation Z begins* . <https://www.pewresearch.org/short-reads/2019/01/17/where-millennials-end-and-generation-z-begins/>
- Muff, K., & Narbel, F. (2020). *The Five Competitive Forces that Shape Strategy*. <https://www.scirp.org/reference/referencespapers?referenceid=2092246>
- Muhammad, M., Oyeibisi Oyefolahan, I., Mikail Olaniyi, O., Joseph Adebayo, O., Solomon Adelowo Salio Adam Muhammad, A., & Ekundayo, A. (2025). SENSITIVITY OF LEARNERS' PRIVACY DATA (LPD) IN MOBILE LEARNING SYSTEM: A FUZZY ANALYTIC HIERARCHY SCHEME (FAHS) SOLUTION. *Technology, Mathematics and Education (JOSTMED)*, 20(1).

- Newton, P. M., & Miah, M. (2017). Evidence-Based Higher Education - Is the Learning Styles "Myth" Important? *Frontiers in Psychology*, 8(MAR). <https://doi.org/10.3389/FPSYG.2017.00444>
- Nurgiansah, T. H., Dewantara, J. A., & Rachman, F. (2020). The Implementation of Character Education in the Civics Education Syllabus at SMA Negeri 1 Sleman. *JED (Jurnal Etika Demokrasi)*, 5(2), 110-121. <https://doi.org/10.26618/JED.V5I2.3106>
- Ophir, E., Nass, C., & Wagner, A. D. (2009). Cognitive control in media multitaskers. *Proceedings of the National Academy of Sciences of the United States of America*, 106(37), 15583-15587. <https://doi.org/10.1073/PNAS.0903620106>
- Ophir, E., Nass, C., & Wagner, A. D. (2019). Cognitive control in media multitaskers. *Proceedings of the National Academy of Sciences of the United States of America*, 106(37), 15583-15587. <https://doi.org/10.1073/PNAS.0903620106>;WEBSITE:WEBSITE:PNAS-SITE;ISSUE:ISSUE:DOI
- Pathollah, A. G., & Wassalwa, S. M. M. (2022). Rekonstruksi Kesadaran Berilmu dalam Pendidikan Pesantren Tinjauan Epistemologis. *Ambarsa: Jurnal Pendidikan Islam*, 1(1), 17-29. <https://doi.org/10.59106/ABS.V1I1.4>
- Patilima, H. (2025). Neurodiversity and trauma in early childhood: Implications for inclusive learning. *South African Journal of Childhood Education*, 15(1). <https://doi.org/10.4102/SAJCE.V15I1.1704>
- Pichler, S., Kohli, C., & Granitz, N. (2021). DITTO for Gen Z: A framework for leveraging the uniqueness of the new generation. *Business Horizons*, 64(5), 599-610. <https://doi.org/10.1016/J.BUSHOR.2021.02.021>
- Poláková, P., & Klímová, B. (2019). Mobile Technology and Generation Z in the English Language Classroom – A Preliminary Study. *Education Sciences 2019, Vol. 9, Page 203*, 9(3), 203. <https://doi.org/10.3390/EDUCSCI9030203>
- Putra, M. Z. V., Siswi, I. R., Putri, S. A., & Apdillah, D. (2026). RANCANGAN SISTEM PENDETEKSIAN KECACATAN PRODUK MENGGUNAKAN VISION LANGUAGE MODEL PADA PLATFORM BERBASIS WEB UNTUK PENGENDALIAN MUTU TANPA PELATIHAN DATA. *Kohesi: Jurnal Sains Dan Teknologi*, 11(1). <https://doi.org/10.2238/HFTX4035>
- Putri, M. D., Mappatempo, A., & Syah, F. (2025). Pengaruh literasi keuangan terhadap perilaku konsumtif : Studi kasus pada mahasiswa Program Studi Manajemen Fakultas Ekonomi dan Bisnis, Universitas Muhammadiyah Makassar, angkatan 2021. *Jurnal Bisnis Mahasiswa*, 5(5), 2302-2309. <https://doi.org/10.60036/JBM.683>
- Raschke, N., Mohsenpour, A., Aschentrup, L., Fischer, F., & Wrona, K. J. (2022). Socioeconomic factors associated with suicidal behaviors in South Korea: systematic review on the current state of evidence. *BMC Public Health*, 22(1). <https://doi.org/10.1186/S12889-022-12498-1>
- Raymond, H. (2024). *Round and Round the Circle: A System- Contextual Integrative Model of "Generations"* (Strauss & Howe, 1991). https://www.researchgate.net/publication/380126864_Round_and_Round_the_Circle_A_System-Contextual_Integrative_Model_of_Generations_Strauss_Howe_1991
- Rohadi, T., & Utami, D. (2025). Developing an AI and Generative AI Literacy Framework: A Lesson from an Islamic Higher Education Institution. *Journal of Language and Literature Studies*, 5(4), 1077-1086. <https://doi.org/10.36312/7tjb1p58>
- Rue, P. (2018). Make Way, Millennials, Here Comes Gen Z. *About Campus*, 23(3), 5-12. <https://doi.org/10.1177/1086482218804251>
- Rusydiana, A., Ruhana, A., & As-Salafiyah, A. (2023). PROBLEMATIKA PENERAPAN JAMINAN PRODUK HALAL DI INDONESIA: ANALISIS TATA KELOLA HALAL. *Harmoni*, 22(1), 167-186. <https://doi.org/10.32488/HARMONI.V1I22.572>
- Sari, N., Azimah Dianah, Hafidhah, & Khairun Nisa. (2025). Measurement Of Halal Certification Quality Of Service On Business Satisfaction In Banda Aceh City. *International Journal of Islamic Economics*, 7(01), 24-36. <https://doi.org/10.32332/ijie.v7i01.10173>

- Sawal, S., & Saifi, I. L. (2025). COMMUNITY PREFERENCES FOR PRIVATE ISLAMIC EDUCATION IN MASOHI CENTRAL MALUKU. *Conciencia*, 25(2), 199-212. <https://doi.org/10.19109/RZBYKB60>
- Serebro, I., Ben-Yehudah, G., Elgavi-Hershler, O., Grobgeld, E., Katzof, A., Luzzatto, E., Shalom, M., & Zohar-Harel, T. (2024). Agents of change: integration of neuropedagogy in pre-service teacher education. *Frontiers in Education*, 9. <https://doi.org/10.3389/FEDUC.2024.1369394>
- Shatto, B., & Erwin, K. (2016). Moving on From Millennials: Preparing for Generation Z. *Journal of Continuing Education in Nursing*, 47(6), 253-254. <https://doi.org/10.3928/00220124-20160518-05>;SUBPAGE:STRING:ABSTRACT;WEBSITE:WEBSITE:SLACK-SITE;REQUESTEDJOURNAL:JOURNAL:JCEN;JOURNAL:JOURNAL:JCEN;WGROU:STRING:PUBLICATION
- Shorey, S., Chan, V., Rajendran, P., & Ang, E. (2021). Learning styles, preferences and needs of generation Z healthcare students. *Nurse Education in Practice*, 57, 103247. <https://doi.org/10.1016/J.NEPR.2021.103247>
- Silveira, J. J. X. da. (2021). *The Shallows What the Internet Is Doing to Our Brains*. <https://www.scirp.org/reference/referencespapers?referenceid=3035454>
- Sippel, L. M., Liebman, R. E., Schäfer, S. K., Ennis, N., Mattern, A. C., Rozek, D. C., & Monson, C. M. (2024). Sources of Social Support and Trauma Recovery: Evidence for Bidirectional Associations from a Recently Trauma-Exposed Community Sample. *Behavioral Sciences*, 14(4), 284. <https://doi.org/10.3390/BS14040284/S1>
- Slomowitz, R. F., Narayan, A. J., & McGrath, L. M. (2025). Resilience research in learning disabilities: Guiding principles from developmental psychopathology. *Learning and Instruction*, 97, 102090. <https://doi.org/10.1016/J.LEARNINSTRUC.2025.102090>
- Smith, Duane, T. P., & Wilmers, C. C. (2018). Moving through the matrix: Promoting permeability for large carnivores in a human-dominated landscape. *Landscape and Urban Planning*, 183, 50-58. <https://doi.org/10.1016/j.landurbplan.2018.11.003>
- Smith, & Hill, J. (2019). Defining the nature of blended learning through its depiction in current research. *Higher Education Research & Development*, 38(2), 383-397. <https://doi.org/10.1080/07294360.2018.1517732>
- Sousa, A. M. M., Meyer, K. A., Santpere, G., Gulden, F. O., & Sestan, N. (2017). Evolution of the Human Nervous System Function, Structure, and Development. *Cell*, 170(2), 226-247. <https://doi.org/10.1016/j.cell.2017.06.036>
- Šramková, M., & Sirotiaková, M. (2021). Consumer Behaviour of Generation Z in the Context of Dual Quality of Daily Consumption Products on EU market. *SHS Web of Conferences*, 92, 06038. <https://doi.org/10.1051/SHSCONF/20219206038>
- Sriram, K. (2023). To What Extent Does Social Media Usage Impact the Ability to Delay Gratification and Attention Span of Teenagers in Mumbai? *British Journal of Multidisciplinary and Advanced Studies*, 4(6), 71-86. <https://doi.org/10.37745/BJMAS.2022.0363>
- Strauss, W., & Howe. (2015). *Are Our Students Digitally Ready for HE Study? Exploring Student Attitudes to Blended Online Study in a Campus-Based University*. <https://www.sciepub.com/reference/123531>
- Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12(2), 257-285. [https://doi.org/10.1016/0364-0213\(88\)90023-7](https://doi.org/10.1016/0364-0213(88)90023-7)
- Swire-Thompson, B., Butler, L., & Rapp, D. N. (2025). The truth sandwich format does not enhance the correction of misinformation. *Journal of Educational Psychology*, 117(6), 851. <https://doi.org/10.1037/EDU0000961>
- Taufikin, T., Judijanto, L., & Nurhayati, S. (2025). Enhancing Undergraduate Research Writing Using ChatGPT: Effectiveness, Student Perceptions, and Ethical Implications. *Jurnal Edutech Undiksha*, 13(1), 148-157. <https://doi.org/10.23887/JEU.V13I1.94305>
- Tokuhama-Espinosa, Tracey., & Willis, Judy. (2011). *Mind, brain, and education science: a comprehensive guide to the new brain-based teaching*. 438.

- Treve, M. (2024). Integrating Artificial Intelligence in Education: Impacts on Student Learning and Innovation. *International Journal of Vocational Education and Training Research* 2024, Volume 10, Page 61, 10(2), 61–69. <https://doi.org/10.11648/J.IJVETR.20241002.14>
- Uden, L., & Sulaiman, F. (2025). Technological Pedagogical Content Knowledge (TPACK) and Neuroscience for Pedagogical Content Knowledge (PCK). *Digital and Cultural Influences on the Development of Pedagogical Content Knowledge (PCK) and TPACK*, 101–156. <https://doi.org/10.4018/979-8-3373-2267-4.CH005>
- Vizcaya-Moreno, M. F., & Pérez-Cañaveras, R. M. (2020a). Social Media Used and Teaching Methods Preferred by Generation Z Students in the Nursing Clinical Learning Environment: A Cross-Sectional Research Study. *International Journal of Environmental Research and Public Health*, 17(21), 1–10. <https://doi.org/10.3390/IJERPH17218267>
- Vizcaya-Moreno, M. F., & Pérez-Cañaveras, R. M. (2020b). Social Media Used and Teaching Methods Preferred by Generation Z Students in the Nursing Clinical Learning Environment: A Cross-Sectional Research Study. *International Journal of Environmental Research and Public Health* 2020, Vol. 17, Page 8267, 17(21), 8267. <https://doi.org/10.3390/IJERPH17218267>
- Wafa, A., Syarifah, S., & Nadhif, Moh. (2025). Transformasi Pembelajaran Pendidikan Agama Islam Berbasis Deep Learning: Dari Pendekatan Hafalan Menuju Internalisasi Nilai. *Academicus: Journal of Teaching and Learning*, 4(2), 103–116. <https://doi.org/10.59373/ACADEMICUS.V4I2.95>
- Waseem, U., & Rahim, A. (2025). Islamic Ethical Perspectives on AI and Digital Transformation in the 21st Century. *Wah Academia Journal of Global Religions*, 1(3), 31. <https://doi.org/10.63954/4SZ9D580>
- Wiedmer, T., & Delta, B. (2015). *Generations Do Differ: Best Practices in Leading* - ProQuest. <https://www.proquest.com/docview/1770514324?sourcetype=Scholarly%20Journals>
- Wijaya, P., Suswati, E., & Wijayanti, T. C. (2024). Strategi Komunikasi Berbasis Digital Dalam Upaya Peningkatan Keputusan Masuk Mahasiswa Baru : (Studi Kasus: Sekolah Tinggi Agama Buddha (STAB) Kertarajasa Batu). *Jurnal Teknologi Dan Manajemen Industri Terapan*, 3(3), 792–801. <https://doi.org/10.55826/JTMIT.V4I3.978>
- Wu, R., & Yu, Z. (2024). Do AI chatbots improve students learning outcomes? Evidence from a meta-analysis. *British Journal of Educational Technology*, 55(1), 10–33. <https://doi.org/10.1111/BJET.13334>
- Wu, Y. (2023). Integrating Generative AI in Education: How ChatGPT Brings Challenges for Future Learning and Teaching. *Journal of Advanced Research in Education*, 2(4), 6–10. <https://doi.org/10.56397/JARE.2023.07.02>
- Xia, Q., Chiu, T. K. F., Chai, C. S., & Xie, K. (2023). The mediating effects of needs satisfaction on the relationships between prior knowledge and self-regulated learning through artificial intelligence chatbot. *British Journal of Educational Technology*, 54(4), 967–986. <https://doi.org/10.1111/BJET.13305;PAGE.STRING:ARTICLE/CHAPTER>

▪