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NEUROEDUCATIONAL ASSESSMENT DESIGN OF ISLAMIC RELIGIOUS EDUCATION IN THE ERA OF SOCIETY 5.0

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Abstract

This study designs a neuroscience-based Islamic religious education assessment in the era of society 5.0 that combines neuroscience and learning evaluation to assess cognitive, affective, and psychomotor aspects. Using a Systematic Literature Review (SLR) approach with PRISMA methodology, this study synthesized findings from 23 articles published between 2014 and 2025. The PRISMA approach was used for data analysis, which is a systematic review that aims to screen, evaluate, and report the literature transparently. The steps of data analysis with PRISMA involved a process of identification, screening, feasibility assessment, and inclusion of relevant literature. The results of this study compiled a neuroscience-based neuroeducational assessment design in Islamic education learning based on Paul D. Maclean's theory (triune brain), which is expected to contribute to assessment innovation in Islamic education to answer the needs of the learning process that is relevant to the challenges and potential of society 5.0.

Keywords Neuroscience, Assessment, Islamic Religious Education, Era Society 5.0.

INTRODUCTION

Learning evaluation of Islamic Religious Education (PAI) still faces various challenges in line with the increasing complexity of 21st-century educational needs (Teti Sumiati & Septi Gumiandari, 2022). One of the main problems is the dominance of cognitive aspects in the assessment process, where evaluations often focus only on memorization skills, written tests, and oral tests (Lugowi et al., 2025). The cognitive domain is the main concern, while the affective and psychomotor aspects tend to be less fully mapped and not systemically integrated in the assessment system (Rosyidah et al., 2024). In fact, the essence of Islamic education is to form a person who not only understands religious teachings conceptually, but is also able to live and practice these values in everyday life (Maulidia & Febriarsita, 2024). As stated by Immordino-Yang & Damasio, "We feel, therefore we learn"; the learning process that touches the emotional dimension will form a deeper meaning in the minds of students (Wang et al., 2023).

It is important for educators to develop an assessment system that covers all three domains in a balanced manner-cognitive, affective, and psychomotor (Gordeeva et al., 2021). The neuroscience approach can be a bridge in integrating the three, as it explains how the brain works biologically and psychologically in response to the learning process (Pohan et al., 2024). The three domains are actually rooted in the brain's complex interconnected systems. The limbic system regulates emotions and motivation, the prefrontal cortex handles moral decisions and reflection, while the hippocampus processes long-term memory that is important in shaping spiritual experiences. The brain is not just a biological organ, but an integration center that influences the process of thinking, feeling, and acting (Sari, 2020). Therefore, it is necessary to develop assessment instruments that are aligned with students' learning styles and neurological development, such as project assessments, narrative observations, or value-based social simulations (Dewi et al., 2018).

Meanwhile, the Society 5.0 era, which emphasizes the integration of technology and human values, demands a smarter and more humanist evaluation model. Education must be able to produce a generation that is not only academically proficient but also has empathy, character, and high social awareness (Susanto, 2023). The evaluation model used must be adaptive, responsive, and based on a deep understanding of the behavior and brain development of students (Maryam et al., 2021). In this context, neuroscience-based assessments allow teachers to understand the potential and learning needs of individual students. Activation of brain areas such as the limbic and prefrontal cortex can be an indicator in evaluating religious understanding and internalization of Islamic

teaching values more deeply (F. Saputra, 2023). Research by Colón-Rodríguez et al shows that brain-based approaches involving emotions and hands-on practice increase learning effectiveness. In fact, neuroscience-based education programs are able to reduce behavioral deviations and improve the quality of students' moral decision-making (Debenham et al., 2022; Suyadi, 2022).

Some previous studies have tried to integrate neuroscience into Islamic education. For example, (Suyadi, 2019) examined the hybridization of Islamic education and neuroscience: between aql in the Koran and brain science in neuroscience, added research (Suyadi, 2022) developing a neuroscience-based taxonomy of Islamic learning that accommodates students' intellectual, emotional, and spiritual aspects, and emphasizes the importance of understanding the structure and function of the brain in designing PAI learning. In addition, Jailani (2023) and Pohan et al. (2024) also highlighted the importance of a neuroscience-based approach to address the challenges of Islamic education in the Society 5.0 era, as well as the trend of neuroscience, which is currently being discussed again (Azzahra & Dwiputra, 2023). These five studies provide important contributions, but have not specifically discussed neuroeducational assessment in the context of evaluating PAI learning, especially in the midst of current technological and social transformations.

Thus, there is a research gap in this study that can answer the demands of the times and opportunities for the application of neuroscience in PAI assessment in the era of Society 5.0. Thus, this study aims to integrate the neuroeducational assessment approach in PAI subjects. This study will answer three problem formulations, namely knowing the global landscape or trends and developments of neuroscience studies in educational evaluation globally and nationally, (2) designing neuroeducational assessment based on brain function in PAI learning, and (3) analyzing the challenges and opportunities of applying this approach in PAI learning in the era of Society 5.0 with the hope that this research can be a reference for further assessment development.

METHOD

The method applied in this study is Systematic Literature Review (SLR) which aims to identify, evaluate, and interpret the results of research relevant to a particular research question, topic area, or phenomenon being studied (Maluf, 2022) and combined with bibliometric methods to see the landscape of research in the last 10 years. SLR is conducted with a structured method to analyze the implementation of neuroscience in the assessment of Islamic religious education, through systematic analysis of data from the Scopus and Sinta databases, which have passed the

screening process through the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) data collection technique with inclusion and exclusion criteria or restrictions, including publications in the last 10 years and relevant to the topic (Shaban et al., 2024). To facilitate and limit the results of the study, the following research questions were formulated:

Table 1. Research Question and Focus

RQ1 :	What is the global landscape of neuroscience studies in educational evaluation?
RQ2 :	How is the design of the Neuroeducational Assessment based on brain function in PAI learning?
RQ3 :	What are the challenges and opportunities for the application of Neuroeducational Assessment in PAI learning in the era of Society 5.0?

Then, the data filtering stage keywords or keywords to find data sources and literature that are in accordance with the research theme. The data taken is Scopus and Sinta-indexed research data through the publish or perish platform and Scopus exported through the Mendeley application, national journals, and international journals, with languages and years that have been determined by researchers. Then the keywords are assessment, school, neuroscience, Islamic education, and psychological. Then the researcher determines the inclusion and exclusion data criteria as shown in Table 2 below.

Table 2. Inclusion and Exclusion Criteria

Criteria	Description	Inclusion	Exclusion
Quality	Duplication		0
	Not readable by the Mendeley Application		0
Data Extraction	Sinta and Scopus	0	
Publishing	Journal articles	0	
	Conferences		0
	Dissertations/theses		0
	Book	0	
Language	Indonesian, English	0	
Access	Virtual	0	
	Paper		0
Year	2015 - 2025	0	
Type of Study	Empirical		0
	Theoretical	0	
Methodology	Quantitative	0	
	Qualitative	0	
Field of Study	An assessment, school, evaluation, Islamic education, and psychological	0	

Abstract	Theme in accordance with research	0

Table 2 above displays the inclusion and exclusion criteria used in the literature search. These criteria include several aspects, namely quality, publication type, language, access, year, study type, methodology, study domain, and abstract. In the quality criteria, articles that are duplicates or not readable by the Mendeley application will be excluded. In terms of publication type, only journal articles, conferences, dissertations/theses, and books were considered. The language criteria allowed Indonesian and English publications. Access to literature can be in the form of virtual (online) or printed (paper) publications.

The publication year limitation is from 2015 to 2025, from Sinta and Scopus indexed article data extracted through the help of the Publish or Perish application to ensure the relevance and currency of the data. The types of studies accepted include empirical and theoretical studies, with qualitative and quantitative methodologies allowed. Study domains include assessment, school, neuroscience, Islamic education, and psychological. In the abstract section, the research theme must match the main topic of the research.

After the inclusion and exclusion stages, the study selection process was transparent, starting from the identification to the inclusion of the final relevant studies. The article selection process for the purpose of this systematic literature review (SLR) is displayed and explained through the PRISMA flow diagram in Figure 1 below.

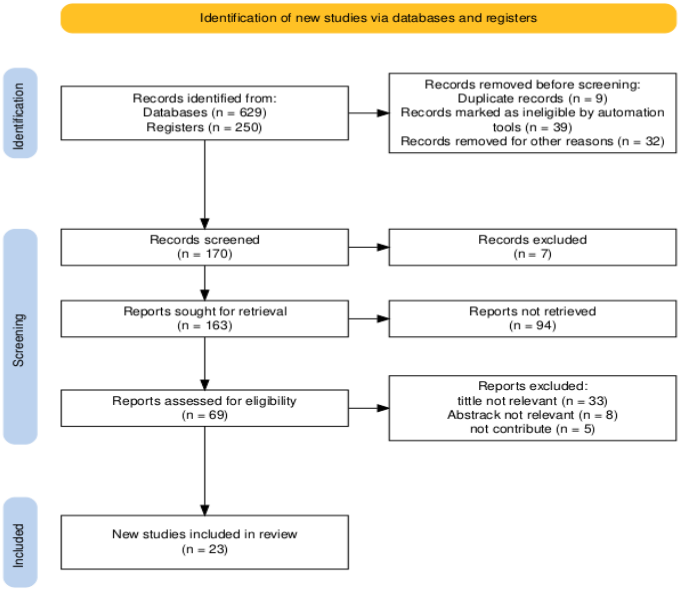

Figure 1. PRISMA Diagram

In the early stages of the identification process, researchers found as many as 879 articles sourced from Sinta journals (629 articles) and Scopus journal data (250 articles). However, before entering the screening stage, there were eight duplication articles, 39 unsourced articles, and 32 conference/non-journal data articles. From the screening results, the remaining 170 articles were examined, then filtered back to 163 articles for further analysis. Unfortunately, 94 articles could not be fully accessed, so only 69 articles could be thoroughly evaluated for eligibility. The evaluation was conducted by looking at the suitability of the title, abstract, and contribution to the research topic.

After the eligibility stage, 46 articles were eliminated due to irrelevance. Finally, 23 articles were selected as eligible sources and used in the literature review. This process shows how the literature selection is carried out strictly and systematically so that the research results are truly supported by valid and relevant references.

FINDINGS AND DISCUSSION

Findings

Based on the search results from the Scopus and Google Scholar databases using the keywords assessment, school, neuroscience, Islamic education, and psychological, 879 articles were initially identified. After going through the identification process using Mendeley software, 23 articles were obtained that met the predetermined criteria for inclusion. Some journals that have been included and excluded will then be mapped based on the focus of the discussion, which this discussion seeks to facilitate researchers in discussing or answering research questions, as in Table 3 below.

Table 3. Mapping the Discussion

Discussion	Number of Articles
School psychological assessment	6
trends and applications of neuroscience in schools	8
Evaluation of PAI learning in the 5.0	5
The Brain's working system in neuroscience	4

Based on Table 3, which maps the discussion of the articles analyzed, it can be seen that the topic of trends and applications of neuroscience in schools occupies the largest portion, with eight articles, followed by school psychological assessment with six articles. Meanwhile, studies that directly discussed the Evaluation of PAI learning in the 5.0 were only found in 5 articles, and the

topic of the brain's working system neuroscience was discussed in 4 articles. After finding 23 articles, a brief description of the articles was made in Table 4 as follows.

Table 4. Article Findings

No	Authoor	Tittle	Result
1.	(Azzahra & Dwiputra, 2023)	Trends in the Implementation of Brain-Based Learning in Indonesia	Identify the trend of brain-based learning implementation in Indonesia with a systematic literature approach
2.	(Febrialismanto & Haryanto, 2023)	International Journal of Neuroscience-Based Learning in Schools: Bibliometric Analysis	Bibliometric analysis shows a significant increase in studies on neuroscience-based learning in schools
3.	(Xu et al., 2022)	Mapping Neuroscience in the Field through a Bibliometric Analysis	Mapping neuroscience topics in education globally and highlighting the surge of neuro applications in the curriculum
4.	(Lindayani et al., 2019)	Pembelajaran Berbasis Neuroscience Berdasarkan Perspektif Guru PAUD	Teachers begin to understand and apply neuroscience principles in early childhood learning activities
5.	(Muttaqin et al., 2024)	Integrasi Neurosains Dalam Pendidikan	Literature review shows the urgency of brain approaches in personalized and adaptive learning.
6.	(Maryam et al., 2021b)	Trend Riset Neuropedagogi dan Implementasinya dalam Pendidikan	Demonstrates a shift in research towards the integration of neuropedagogy in general and Islamic education
7.	(Dia'ul Adha, 2025)	Eksplorasi Neuroedukasi dalam Pembelajaran Bahasa Indonesia	Explores neuroscience-based approaches to improving language competence
8.	(Faiza Amaliyah & Hasan, 2025)	Integrating Digital Learning Tools into the Arabic Language Curriculum	Integration of digital tools and neuroscience supports the effectiveness of Arabic language learning
9.	(Maluf, 2022)	School Psychological Assessment Practices: A Systematic Review	Psychological evaluation in schools still lacks an explicit neuroscientific approach
10.	(Gordeeva et al., 2021)	Assessment of School Student Achievement in Traditional vs Developmental Education	Demonstrates the need for adaptive assessments based on students' psychological and neurological conditions
11.	(Pohan et al., 2024)	Neurosains dalam Pendidikan: Peran dalam Pembelajaran Anak Usia Dini	Highlighting the importance of brain-based evaluation from an early age
12.	(Debenham et al., 2022)	Effectiveness of a neuroscience-based harm reduction program	Neuroscience-based program improves adolescent students' self-control and ethical decisions
13.	(Colón-Rodríguez et al., 2019)	Bridge to Neuroscience Workshop	Neuroscience-based workshop increases students' understanding and participation in brain principles
14.	(Fitriwati et al., 2021)	Hypnohappy Learning Model Development	Learning model based on hypnosis and neuroscience to improve students' mental readiness

15.	(Lugowi et al., 2025)	Kisi-Kisi Instrumen Pembelajaran PAI	Shows the dominance of cognitive aspects in PAI assessment
16.	(Rosyidah et al., 2024)	Standardized Assessment and Examination in Islamic Religious Education	Need to redefine holistic evaluation instruments in PAI
17.	(Suprapto, 2015)	Pengembangan Metodologi Pembelajaran PAI Melalui Neuroscience	Suggests the development of brain and information processing-based PAI methods
18.	(Dewi et al., 2018)	Neurosains dalam Pembelajaran Agama Islam	The importance of emotional and spiritual approaches in PAI learning
19.	(Syafaatunnisa et al., 2024a)	Kriteria Evaluasi PAI di Era Society 5.0	Highlighting the need for PAI assessments that are in line with technology and humanity
20.	(Abdiyantoro et al., 2024b)	Sistem Kerja Otak pada Neurosains dalam Upaya Meningkatkan Pembelajaran PAI	Explaining the interrelationship of brain function in improving the effectiveness of PAI learning
21.	(Sousa, 2016)	How the Brain Learns	Explaining brain areas such as the limbic and prefrontal cortex in supporting the learning process
22.	(Aulina, 2018)	Penerapan Metode Whole Brain Teaching	Learning methods that activate all parts of the brain for children's learning motivation
23.	(Saputra et al., 2024)	Model Pembelajaran Berbasis Neurosains	Neuroscience-based problem-based learning model increases brain engagement in learning

Based on the table, it can be concluded that the trend of neuroscience research and implementation in Islamic Religious Education (PAI) shows a significant increase and paradigmatic shift from conventional approaches to more personalized, adaptive, and holistic approaches. Recent studies highlight the importance of integrating brain principles-such as whole brain learning, limbic and prefrontal cortex functions, curriculum design, learning methods, and assessments relevant to the Society 5.0 era. While the traditional approach in PAI evaluation is still dominated by cognitive aspects (Lugowi et al., 2025), a number of studies emphasize the need to redefine assessment models that include affective, spiritual, and social-emotional aspects of students (Dewi et al., 2018; Rosyidah et al., 2024) while utilizing digital technology as an adaptive assessment medium (Syafaatunnisa et al., 2024). The consensus of the literature also shows the urgency of cross-disciplinary collaboration between educators, neuroscientists, and educational technology developers to create learning and assessment systems that are in line with how the brain works and the needs of today's learners.

Discussion

Overall, the 23 articles in Table 4 are related; if analyzed through a word cloud using the R Studio application, the visualization is in Figure 2 below.

Global landscape of neuroscience studies in educational evaluation

Figure 2. Wordcloud Research
(Visualization of Scopus Data Findings, Analysis Through the R Studio Application)

After the 23 articles were analyzed through the R studio application, the emerging trends of keywords such as education, neuroscience, program evaluation, and curriculum showed that the processed literature base indeed focused on education and the development of neuroscience-based evaluation, which is in line with the direction of this research. The dominant presence of neuroscience terms in this word cloud emphasizes that brain-based approaches are a growing concern in global education (Azzahra & Dwiputra, 2023).

However, there are also a number of small-sized terms such as self-evaluation, psychological aspect, curriculum evaluation, and learning which indicate that the specific focus on the integration of neuroscience in educational assessment design, especially in specific fields such as Islamic Religious Education, is still not widely researched, the data in 2020-2022 found a decline in trends began to occur after the pandemic from thousands of initial articles, only 92 of which met systematic criteria (Azzahra & Dwiputra, 2023). So, this is a great opportunity to offer new contributions, because there are still few studies that directly link brain function with the design of religious values-based educational assessments (Syafaatunnisa et al., 2024a), especially within the framework of Society 5.0, which emphasizes the connection between technology, humanism, and character-based education.

Thus, this wordcloud not only shows a strong connection with this research, but also shows a research gap that can be raised as the topic of this research, namely, analyzing a neuroscience-based PAI evaluation model to enrich adaptive and transformative assessment approaches in the era of education society 5.0. The small frequency of this term in (Febrialismanto & Haryanto, 2023) wordcloud indicates that the topic is still a relatively new area and has not been widely explored, so it is very relevant and has the potential to make a significant scientific contribution in the realm of education and Islamic studies (Abdiyantoro et al., 2024).

Based on the results of word frequency analysis in global scientific publications in the last 10 years, even from 1999 to 2025, it can be seen that the terms education and neuroscience have experienced a consistent and significant increase, especially since 2015, as shown in Figure 3 below.

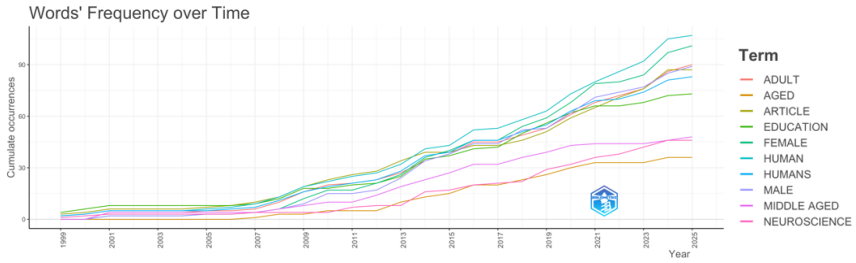

Figure 3. Word Frequency Over Time
(Visualization of Scopus Data Findings, Analysis Through the R Studio Application)

The graph shows that interest in research in education and neuroscience continues to grow (Azzahra & Dwiputra, 2023), reflecting the growing academic awareness of the importance of brain-based approaches in improving the quality of education. The data shows that the integration of neuroscience into the education system, including in terms of learning evaluation, is of great concern in the global academic world.

However, despite the increasing use of the terms education and neuroscience, the specific focus on developing neuroscience-based assessments in the context of Islamic Religious Education (PAI) has not been widely explored. This indicates a great research opportunity and a new area of contribution for this study. With data showing acceleration from 2015 to 2025, the development of a Neuroeducational Assessment approach in PAI evaluation is very relevant and has academic urgency to be developed in response to the need for educational assessment innovation in the Society 5.0 era. Likewise, the country analysis in research that discusses evaluation with neuroscience is shown in Figure 4 below.

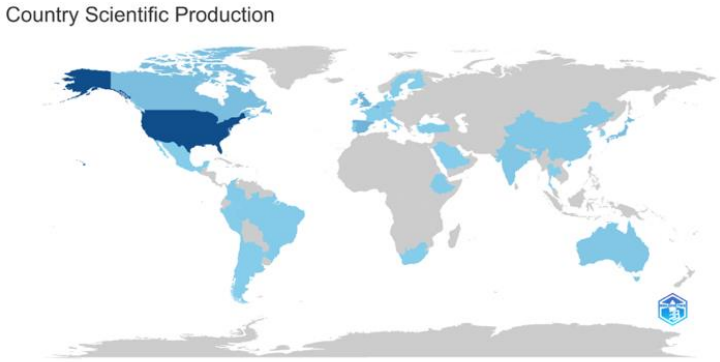

Figure 4. Country Scientific Production
(Visualization of Scopus Data Findings, Analysis Through the R Studio Application)

Analysis of the global scientific production map shows that research development related to education, assessment, and neuroscience is still dominated by developed countries such as the United States, the United Kingdom, Germany, Japan, and China (Febrialismanto & Haryanto, 2023). Meanwhile, the contribution of Southeast Asian countries, including Indonesia, in studying the integration between the principles of neuroscience and education, especially in the field of Islamic Religious Education (PAI), is still relatively minimal. This gap indicates a wide scientific space for innovation and the development of new research in the region.

Neuroeducational Assessment Design Based on Brain Function in PAI Learning

The Systematic Literature Review conducted in this study shows that various parts of the human brain have specific roles in supporting the religious learning process. In his book (Sousa, 2016), How the Brain Learns, which explains that meaningful learning requires activation of the prefrontal cortex area (executive function), limbic system (emotional processing and motivation), and association area (part of the cerebral cortex) for information integration and meaning. Similarly, when students are invited not to simply memorize religious teachings, but to contemplate, live, and relate them to the context of real life, these various brain areas will be more optimally involved in the learning process.

Similar findings by Abdiyantoro et al. (2024) highlight the importance of teachers' understanding of the brain's working system in designing PAI learning and assessment. They asserted that learning that does not consider how the brain works will more easily create learning experiences that touch deeply on spiritual and moral aspects (Suprapto, 2015).

One of the most famous neuroscience theories is the triune brain theory proposed by Paul D. Maclean that the human brain is divided into three parts, namely the reptilian complex (brainstem and cerebellum), limbic system (septum, amygdala, hypothalamus, hippocampus, and cingulate

cortex), and neo cortex (cerebrum/frontal lobe, parietal lobe, temporal lobe, and occipital lobe) which is also known as the learning brain (Fitriwati et al., 2021). The three layers of the brain are interrelated in a unified organization and are involved in each other's work in complex yet decisive ways, as shown in Figure 5 below.

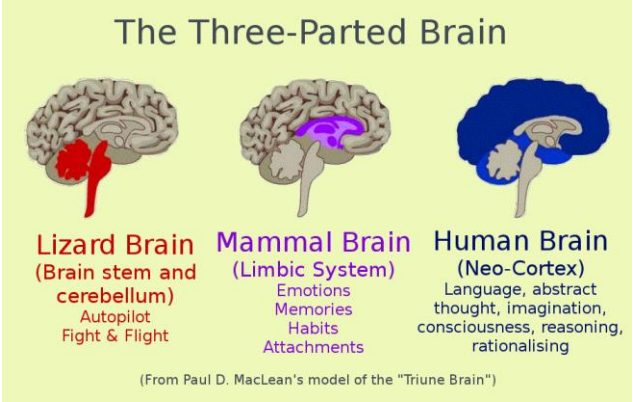

Figure 5. Triune Brain
(Source: the Book How the Brain Learns)

In the affective domain, the limbic system plays an important role in processing the spiritual values taught in PAI. For example, when students are invited to reflect on the meaning of compassion in Islam or the empathy stories of the prophets, emotional engagement is key to reinforcing the meaning of these teachings (Febrialismanto & Haryanto, 2023). This emphasizes the need for reflective or experiential forms of assessment, such as spiritual journal writing, personal narrative writing, or case study-based ethical discussions. This approach will involve more areas of the amygdala and hippocampus that function in storing long-term emotional memory.

Meanwhile, the prefrontal cortex, which is responsible for decision-making and planning, becomes an important point in moral and social evaluation in PAI learning (Suprapto, 2015). Teachers can design assessments that require students to respond to moral dilemmas by referring to Islamic teachings. In this case, the assessment does not only measure the memorization of propositions, but students' ability to think critically, make decisions, and reflect on values contextually. This is in line with the society 5.0 approach that emphasizes the importance of value-based and humanitarian transformative learning.

The integration of neuroscience in assessment design also provides opportunities to vary the type of assessment according to students' learning styles and neurological development. Thus, within this framework, the design of neuroeducational assessment is not rigid, but dynamic and

flexible, depending on the intended competencies and brain functions to be optimized. Assessments can be formative or summative, with a note that each form of assessment must be designed by considering the activation of certain brain functions to be more meaningful and impactful for students' spiritual and moral development (Tsintani, 2024).

Thus, this approach not only answers the demands of Islamic pedagogy oriented towards moral formation but also strengthens the validity of assessment through a scientific brain-based approach. This design is expected to be a bridge between the need for humanistic assessment and the ability of the education system to facilitate students' spiritual development optimally. An example is shown in Table 4 below.

Table 4. Neuroeducational assessment design based on brain function

Types of Brain (Neuroscience Structure)	Cognitive & Affective Function	Application in PAI Learning	Assessment Strategy/Design
Reptilian Brain (Primitive Brain)	- Repetition - Instinct & habit - Basic behavior control (reflexes, safety)	- Habituation of worship - Religious discipline (prayer, daily adab) - Religious routine	- Habit-based observation assessment (adab checklist, worship attendance) - Behavior skill rubric
Limbic System (Emotional Brain)	- Emotion processing - Motivation & empathy - Emotional memory	- Internalization of moral values - Empathy for others (zakat, solidarity) - Exemplary of the Prophet	- Self-reflection & affective journal - Affect-based peer assessment - Story-based evaluation (assessing emotional reaction to the story)
Neocortex (Rational Brain)	- Logical & abstract thinking - Language & creativity - Reasoning & analysis	- Analysis of verses and hadith - Critical discussion of socio-religious themes - Argumentation of Islamic values	- Evaluative Essay - HOTS cognitive test (analysis, evaluation) - Project-based assessment (making interpretation works, religious vlogs, etc.)

Challenges and Opportunities of Applying Neuroeducational Assessment in Islamic Education Learning

The application of neuroeducational assessment in Islamic Education (PAI) learning is a solution in the midst of digital transformation towards the era of Society 5.0 (Syafaatunnisa et al., 2024a), because the demands of this era do not only focus on mastery of cognitive knowledge, but also pay attention to affective, spiritual, and social aspects that are integrated in the learning process. The concept of neuroeducational assessment - an approach that combines neuroscience and learning

evaluation - emerged as one of the answers to this need. However, the application of neuroeducational assessment, especially in PAI subjects, will certainly face various challenges and opportunities. As in the research (Dia'ul Adha, 2025), that limited resources, a lack of teacher understanding, and a curriculum adaptation that has not fully accommodated this neuroscience approach.

First, there is limited technological infrastructure, especially in schools located in the 3T (Disadvantaged, Frontier, and Outermost) areas. Many schools do not have adequate digital devices, such as computers, simple EEG devices, or stable internet access. These limitations certainly hinder the application of neuroscience-based evaluation methods that rely heavily on modern technology. Suhendi (2024) emphasized that infrastructure challenges are one of the main obstacles in Islamic curriculum innovation in the digital era (Faiza Amaliyah & Hasan, 2025).

The next challenge is the lack of knowledge about the neuroscience approach among PAI teachers (Amelia, 2023). Most teachers are still accustomed to teacher-centered teaching approaches, such as the lecture method and memorization tests. This is not in line with neuroeducation principles that emphasize the importance of understanding brain function in the learning process. The lack of training and literature on neuroeducation in the world of Islamic education makes it difficult for teachers to adopt this approach thoroughly. According to Fauziah et al. (2023), there is still a gap between the spiritual approach of Islamic education and scientific approaches such as neuroscience, so the integration of these two approaches requires a special, sustainable strategy.

In terms of curriculum, the application of neuroeducational assessment is also faced with quite complex challenges. With the fulfillment of students' KKM, the PAI curriculum tends to pursue cognitive aspects. So this seems to give less space for affective and spiritual exploration as a whole and measurable. The lack of development of evaluation indicators that are relevant to the psychoneurological science of students means that the application of brain-based assessment will not be easy to do systematically (Siti Umi Khoiriah et al., 2023).

However, behind these challenges, there is a great opportunity to optimize the application of neuroeducational assessment in PAI learning. In the Era of Society 5.0, it opens space for collaboration between education, psychology, and neuroscience that can encourage the birth of evaluation methods that are more humanistic and transformative (Yulianti, 2016). Rapidly developing technology allows teachers to utilize various digital-based learning platforms that provide interactive evaluation features based on emotions and attention, such as AI-based

applications or neurocognitive evaluation platforms. The utilization of this technology allows teachers to map students' learning styles, attentional strengths, and affective responses to the PAI material presented. Thus, facilities and infrastructure must be adequate (Pohan et al., 2024).

Another opportunity lies in improving teachers' competencies through training and continuous professional development. Collaboratively designed training between Islamic education experts and neuroscientists can help teachers understand the basics of brain structures such as the prefrontal cortex, limbic system, and reptilian brain, and how each affects the learning process. This understanding can then be translated into evaluation strategies that not only measure the memorization of verses or hadith, but also the extent to which students understand the meaning and spiritual value of these teachings (Lindayani et al., 2019).

A curriculum that is responsive to changing times is also a strategic opportunity for the application of this approach (Muhajir et al., 2024). The revision of PAI curriculum that accommodates the principles of whole brain learning and executive function allows religious learning to be more meaningful and applicable as in research (Aulina, 2018), learning with an instructional approach derived from neurolinguistic images based on the functions of the right and left brain (Chris Biffle, 2008) because it considers the function of the brain in absorbing and internalizing the values of Islamic teachings, learning can be arranged in stages according to the ability and readiness of the student's brain, ranging from literal, analytic, to reflective understanding.

Compared to the conventional assessment model of PAI, which still predominantly uses objective and essay tests (multiple choice, true-false, matching) as well as simple observation, as found in various studies of SMK and SMA (Nurlitasari & Maemunah, 2024; Nurul Insani & Anshari, 2024), the neuroeducational assessment model expands the dimensions to be participatory, holistic, and student-centered. This is reflected in strategies such as religious project evaluation, spiritual journaling, and observation of daily religious behavior, which measure not only what students know, but also how they feel and make meaning (Yemmardotillah et al., 2024).

The application of neuroeducational assessment also encourages the creation of evaluation strategies that are more participatory and student-centered (Marwa et al., 2024). For example, religious project-based evaluation, expression of emotions in spiritual journals, and observation of daily religious behavior all reflect the process of internalizing Islamic values that are in line with the brain's work processes. This approach helps educators see the deepest side of students' learning

experiences, not only what they know, but also how they feel and make meaning of it (Muttaqin et al., 2024).

So, for this implementation to run optimally, cross-disciplinary collaboration is essential. Collaboration between experts in Islamic education, neuroscience, and psychology can create a holistic and integrated assessment tool and ensure the validity and reliability of the measurement tools used in assessing students' spiritual, affective, and cognitive aspects. Opportunities for the application of neuroeducation are increasingly wide open, along with technological developments and the need for more personalized learning.

CONCLUSION

The neuroeducational assessment approach in Islamic Religious Education (PAI) in the era of Society 5.0 shows high relevance and transformative potential. The results of the analysis of RQ1-RQ3 reveal that although global studies on the integration of neuroscience in education have increased, studies that link it directly to Islamic education assessment are still limited. This research successfully mapped out an assessment design based on the triune brain theory involving the reptilian brain, limbic system, and neocortex, each of which underlies the evaluation strategies for morals, religious emotions, and critical reasoning. Implementation challenges include limited infrastructure, lack of teacher understanding, and a curriculum that is still dominantly cognitive, but opportunities are present through the use of digital technology and cross-disciplinary collaboration. Theoretically, this research enriches the assessment model by adding a spiritual-neuroscience dimension, which brings evaluation closer to authentic and comprehensive learning experiences. The practical implications encourage PAI teachers to design evaluations that involve affective and reflective aspects, and encourage curriculum developers to integrate brain working principles in learning design. The limitation of this study is that no empirical test has been conducted on the effectiveness of the proposed assessment model. Therefore, further research is recommended to conduct field testing through quasi-experimental studies or the development of psychometrically and contextually validated neuroscience-based assessment instruments in PAI learning settings.

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