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# Artificial Intelligence and Teacher Creativity in Center-Based Early Childhood Learning: A Qualitative Study at PG-TKIT 2 Qurrota A'yun Ponorogo

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**ABSTRACT**

This study examines early childhood teachers' creativity in AI-supported center-based learning at PG-TKIT 2 Qurrota A'yun Ponorogo. It applies a descriptive qualitative approach within a constructivist paradigm. Data were collected through participatory observation, semi-structured interviews, and documentation involving six classroom teachers and one school leader. Data were analyzed using thematic analysis based on creativity indicators from J. P. Guilford and E. Paul Torrance, including fluency, flexibility, originality, elaboration, and evaluation. The findings indicate that integrating AI tools such as ChatGPT-4o and Google Gemini appears to enhance teachers' creativity across the planning, implementation, and evaluation stages. In planning, AI supports rapid idea generation and variation. During implementation, it facilitates adaptive and multimodal learning aligned with children's needs. In evaluation, AI contributes to more comprehensive and data-informed assessment practices. AI is also used to generate personalized learning content, including simple narrative adaptations based on children's experiences, which strengthens engagement and contextual relevance. Overall, AI integration contributes to increased student participation, more diverse learning activities, and improved instructional efficiency. However, several challenges remain, including the risk of overdependence on AI, the need to verify content accuracy, and unequal parental digital literacy. These findings imply that AI should function as a supportive pedagogical tool rather than a substitute for teacher judgment. Strengthening teacher training and establishing ethical guidelines are essential to ensure responsible AI use in early childhood education.



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## 1. INTRODUCTION

Early Childhood Education (ECE) plays a crucial role as a foundational stage in the development of children's cognitive, social, emotional, and creative capacities. According to data from the Central Bureau of Statistics (BPS) in 2021, there were approximately 30.8 million preschool-aged children in Indonesia, indicating a substantial population in this early developmental phase [1]. A study by the Indonesian Ministry of Health, as cited in Aghniy (2022), suggests that appropriate stimulation and learning are needed during this critical period. In addition, children's socio-emotional development and creativity are also significant areas of concern [3]. Research by Anjani & Mashudi (2024) indicates that the majority of parents report good socio-emotional development (75.1%) and high levels of creativity (89.5%) in their children, suggesting that interaction within ECE learning environments supports these competencies. These findings reinforce the notion that appropriate early childhood education not only influences academic abilities but also shapes social skills and creativity, which are essential for later life.

Their experiences strongly influence children's readiness to enter primary education in ECE. Those who participate in early childhood education demonstrate greater learning readiness than those who do not, making the transition from ECE to primary school a crucial phase in determining future academic success [5]. Therefore, the quality of learning in ECE, including teachers' creativity in designing innovative and adaptive teaching methods, becomes a key factor in supporting optimal child development [6]. The Center-Based Learning Model is one of the primary approaches in ECE, emphasizing learning through play and exploration across various activity areas or "centers" [7]. Each center is designed to develop specific aspects of child development, such as cognitive, motor, socio-emotional, language, artistic, and moral-religious domains [8]. Common examples of such centers include the Block Center, Role-Play Center, Natural Materials Center, Art Center, and Preparation Center. Through these centers, children are provided with opportunities to learn actively, creatively, and independently according to their interests and developmental levels [9]. According to Werdiningsi (2022), research conducted in several ECE institutions in Indonesia demonstrates that the implementation of center-based learning is effective in stimulating holistic child development, including enhancing problem-solving skills, creativity, and social interaction. Furthermore, Kasiati et al (2023) found that those in conventional classroom-based learning environments.

The success of the center-based learning model largely depends on teachers' creativity in designing and implementing learning activities. This creativity encompasses the ability to select appropriate methods and media, as well as to adapt activities to children's characteristics and needs[12]. Creative teachers can integrate activities, such as constructive play in the Block Center and artistic activities in the Creativity Center, to stimulate fine motor development and children's imagination [13]. Research by Firmawanti et al. (2024) examined children's independence, cooperation, and creativity, with statistical test results showing a Sig. (2-tailed) value < 0.05. In addition, teachers' ability to adapt to technology further enriches the learning process, making it more interactive and engaging (Hidayah & Utami, 2023). Thus, teacher creativity becomes a key

determinant in the successful implementation of center-based learning and the optimal development of early childhood learners.

Based on interviews with the principal of PG-TKIT 2 Qurrota A'yun Ponorogo, Mrs. Yuni Lestari, S.Pd, conducted on October 3, 2025, it was revealed that although teachers demonstrate high dedication in educating children, they face various challenges in integrating technology, particularly Artificial Intelligence (AI), into center-based learning activities. Prior to the implementation of AI-based technology, teachers primarily relied on Google Search and conventional learning resources such as guidebooks, children's worksheets, and general internet materials. The use of technology remained basic and passive, limited to searching for references without further innovation in developing learning media or instructional methods. Consequently, center-based learning activities tended to be monotonous, less interactive, and limited in terms of teacher creativity.

With technological advancements, AI began to be introduced on a limited basis in early 2025. Teachers utilized available computers and tablets to access interactive educational programs that help children recognize basic concepts such as numbers, letters, colors, and shapes. Follow-up interviews conducted on October 10, 2025, with several teachers Mrs. Lilik Prihatin, S.Pd; Retno Ayu, S.Pd; Mrs. Enyf Fahria, S.Pd; Mrs. Grynda Indahsari, S.Pd; Mrs. Farida, S.Pd; and Mrs. Farikha, S.Pd indicate that the introduction of AI has begun to enhance teacher creativity in developing instructional media, selecting teaching methods, and designing more engaging and participatory center activities for children.

The use of AI assists teachers in obtaining inspiration and new references quickly and in alignment with the needs of early childhood learners. However, the implementation of AI at PG-TKIT 2 Qurrota A'yun Ponorogo remains largely assistive, functioning primarily as a supporting medium for learning activities such as educational games, sound recognition, and interactive coloring tasks. This indicates that AI has not yet been fully integrated into the curriculum and center-based learning processes. Nevertheless, the transition from conventional technology to more innovative AI-based applications suggests an increase in teacher creativity within the learning process. Despite this, the phenomenon has not been extensively studied. Therefore, an in-depth analysis of teacher creativity in designing and implementing center-based learning is essential, particularly in ECE institutions such as PG-TKIT 2 Qurrota A'yun Ponorogo, to ensure optimal educational quality and support holistic child development.

Based on these conditions, this study aims to analyze the level of teacher creativity in implementing center-based learning at PG-TKIT 2 Qurrota A'yun Ponorogo, evaluate the extent to which AI integration can support the learning process, identify challenges and teacher needs in effectively utilizing AI, and provide strategic recommendations for the development of more innovative, technology-based ECE learning. Practically, this study is expected to offer valuable insights for teachers and school management in designing creative center-based learning strategies and optimizing the use of AI, as well as to serve as a foundation for teacher training programs, curriculum development, and the provision of technological infrastructure that supports the teaching and learning process. Theoretically, this research is expected to contribute to future studies on integrating technology and

teacher creativity in early childhood education, particularly regarding the use of AI in improve the quality of ECE. Ultimately, the implementation of the findings is expected to foster more innovative, interactive, and adaptive learning at PG-TKIT 2 Qurrota A'yun Ponorogo, thereby maximizing children's cognitive, socio-emotional, and creative development and enhancing their readiness for subsequent levels of education.

## 2. METHOD

This study employs a qualitative, descriptive design grounded in the constructivist paradigm to gain an in-depth understanding of teachers' creativity in AI-based center-based learning at PG-TKIT 2 Qurrota A'yun Ponorogo. Data were collected naturally through participatory observation, semi-structured in-depth interviews, and documentation, with classroom teachers as the primary subjects and key informants, including the school principal and other educators. The study was conducted from November 2025 to February 2026, focusing on exploring teachers' processes, experiences, and strategies in integrating Artificial Intelligence (AI) into learning activities. The research instruments were based on Guilford's creativity indicators fluency, flexibility, originality, elaboration, and evaluation applied across the stages of planning, implementation, and evaluation of center-based learning. This approach enables a comprehensive analysis of innovative teaching practices and the development of teacher creativity within the context of early childhood education.

## 3. RESULTS AND DISCUSSION

### 3.1. Result

**Center-Based Learning Planning with the Utilization of Artificial Intelligence (AI) at PG-TKIT 2 Qurrota A'yun Ponorogo**

The results of in-depth interviews conducted with three key informants, Principal Yuni (March 13, 2026), Teacher Lilik (March 9, 2026), and Teacher Farida (March 11, 2026) at PG-TKIT 2 Qurrota A'yun Ponorogo—indicate that AI-based center learning planning has been implemented in a systematic, collaborative, and structured manner. This implementation is not solely focused on the technical aspects of instruction but also integrates the values of integrated Islamic education and the principles of early childhood development. The findings suggest that AI functions as a supporting instrument in strengthening pedagogical creativity, learning differentiation, and innovation in planning based on children's individual needs through five main indicators: fluency, flexibility, originality, elaboration, and evaluation.

1. **Fluency in AI-Based Center Learning Planning**

   Fluency, as a primary indicator of divergent creativity according to Torrance (1966), refers to the ability to generate a large number of ideas or alternative solutions in a short time. In the context of AI-based center-based learning planning, interview results reveal a significant improvement in early childhood teachers' ability to generate varied, creative, and contextually relevant learning ideas. AI acts as a catalyst for idea generation, enabling teachers to transcend conventional cognitive limits by producing dozens of activity options within minutes. Principal Yuni (March 13, 2026) described this routine through a structured weekly forum: *"Every week we hold a planning*

*meeting, then open ChatGPT with prompts such as 'Generate 10 center activity ideas for children aged 4–5 on the theme of honesty and trustworthiness inspired by the Prophet.' From this, various ideas emerge, such as interactive storytelling, role-playing companions of the Prophet, and Islamic market simulations, which we further develop."* This illustrates AI as a trigger for fluency, where a single prompt can generate more than ten ideas, increasing efficiency from 2–3 manual ideas to more than 20 variations per session.

Teacher Lilik (March 9, 2026) complemented this with her experience: *"I created 10 center activity ideas, including a Qur'an-based water cycle story, personalized daily reflection cards for children, and trust-value puzzle games."* She noted that without AI, the process would take 2 days, but now it takes only 30 minutes, allowing variation across cognitive (puzzles), affective (reflection), and spiritual (Qur'anic stories) domains. Teacher Farida (March 11, 2026) added: *"AI generates interactive Islamic songs, age-appropriate role-play of the Prophet's companions, and meaningful art patterns such as simple calligraphy themed on honesty."* All three emphasized that AI-driven fluency is not merely quantitative but also contextualized within the Merdeka Curriculum, creating a dynamic center-based learning ecosystem.

2. **Flexibility in Adapting Learning Planning**

Flexibility refers to the ability to shift across categories of ideas or perspectives adaptively (Guilford, 1967), which is essential in heterogeneous early childhood learning contexts. The interviews reveal teachers' flexibility in transforming AI outputs into various modes to meet students' needs, thereby avoiding rigid approaches. Principal Yuni (March 13, 2026) emphasized multimodal adaptation: *"AI-based learning media are transformed into printed materials for face-to-face learning, instructional videos for hybrid settings, and interactive digital activities for online learning, such as QR-code-based Prophet stories accessible via mobile phones."* This reflects structural flexibility, where one AI-generated idea is converted into three media formats.

Teacher Lilik (March 9, 2026) focused on individual differentiation: *"Active children are directed to gross motor activities such as AI-based Islamic market simulations, while passive children engage in calmer activities such as drawing the Qur'anic water cycle or listening to personalized stories."* Teacher Farida (March 11, 2026) added an instructional dimension: *"We adjust AI prompts such as 'Adapt role-play of the Prophet's companions for a shy 4-year-old child' to match cognitive abilities, resulting in variations from group play to reflective solo activities."* These findings demonstrate holistic flexibility, from prompt design to implementation, aligned with Vygotsky's differentiation principles.

3. **Originality in Learning Planning Innovation**

Originality assesses the uniqueness and novelty of ideas, distinguishing them from conventional approaches. The use of AI fosters authentic innovation that integrates children's experiences with Islamic values, surpassing standard templates. Principal

Yuni (March 13, 2026) introduced the concept of *"AI Moral Mirror"*: *"Children who are afraid of the dark are provided with stories about the bravery of Prophet Muhammad (peace be upon him), complete with AI-generated visuals and personalized reflective questions."* This innovation is unique because it personalizes prophetic narratives based on each child's observational data.

Teacher Farida (March 11, 2026) reinforced this: *"This approach produces distinct learning experiences for each child, such as custom Islamic songs for shy children or calligraphy art themed on trustworthiness, which had not been previously conceived and are far more meaningful than uniform methods."* Teacher Lilik (March 9, 2026) added a reflective dimension: *"We created unique AI-generated daily cards combining the Qur'anic water cycle with children's personal journals on honesty."* Collectively, the findings indicate that AI-driven originality shifts learning from a mass approach to an individualized-reflective model, consistent with studies on AI-based educational personalization.

**4. Elaboration in Integrative and Ethical Planning**

Elaboration measures the depth of idea development, encompassing technical, pedagogical, and ethical dimensions. The interviews highlight comprehensive elaboration, ensuring that AI aligns with integrated Islamic education. Principal Yuni (March 13, 2026) explained: *"Every prompt in ChatGPT-4o or Google Gemini includes elements such as the 4–5 age group, Islamic values like the Prophet's trustworthiness, and Piaget's developmental stages to ensure alignment with the Merdeka Curriculum."*

Teacher Lilik (March 9, 2026) emphasized verification: *"All AI outputs are reviewed by teachers for accuracy, such as ensuring Qur'anic water cycle stories align with correct verses and are appropriate for children."* Teacher Farida (March 11, 2026) prioritized ethics: *"We prohibit the use of children's personal data, require parental consent for digital activities, and always cross-check Islamic values with authoritative texts."* This elaboration establishes an ethical-pedagogical framework that minimizes AI bias and ensures multidimensional depth.

**4. Evaluation in Validating Learning Planning**

Evaluation assesses effectiveness through reflective cycles and empirical data, ensuring sustainable innovation. This mechanism includes pilot testing and both quantitative and qualitative metrics. Principal Yuni (March 13, 2026) explained: *"Each plan is tested at least twice by teachers and evaluated in weekly forums using rubrics measuring children's engagement and alignment with the Merdeka Curriculum."* Teacher Lilik (March 9, 2026) focused on children's responses: *"Evaluation considers enthusiasm during activities such as the water cycle or daily reflections, with an average score of 4.5 out of 5 from 20 children."*

Teacher Farida (March 11, 2026) measured interaction: *"The effectiveness of AI-generated songs and games is assessed through children's attention span (increasing by 15 minutes) and the quality of discussions on trustworthiness values."* Overall

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results indicate an 80% increase in student enthusiasm, a 50% increase in activity variation, and a 40% improvement in teacher efficiency. Challenges such as technological dependency are addressed through training, while the benefits remain dominant under Islamic educational supervision.

**Implementation of Center-Based Learning with the Utilization of Artificial Intelligence (AI) at PG-TKIT 2 Qurrota A'yun Ponorogo**

The results of in-depth interviews with Principal Yuni (March 13, 2026), Teacher Lilik (March 9, 2026), and Teacher Farida (March 11, 2026) at PG-TKIT 2 Qurrota A'yun Ponorogo indicate that the implementation of AI-based center learning has been conducted in a dynamic, adaptive, and interactive manner. This implementation integrates digital technology, early childhood pedagogy, and the values of integrated Islamic education, which are consistently applied in daily learning activities. The findings suggest that AI functions not only as an instructional support tool but also as a real-time pedagogical decision-support system in the center-based learning process, as reflected in five main indicators: fluency, flexibility, originality, elaboration, and evaluation.

1. **Fluency (Real-Time Generative Capacity of Ideas within the Dynamics of the Center Ecosystem)**

   Fluency, as a primary indicator of divergent creativity, refers to the cognitive ability to produce a quantity of alternative ideas within a limited timeframe. In the context of AI-based center learning implementation, this is optimally realized through artificial intelligence as an idea-generation engine responsive to classroom dynamics. Teacher Lilik, in an interview on March 9, 2026, articulated this application comprehensively: *"During implementation, I use AI for many things: creating personalized Islamic daily missions for the preparation center, instantly analyzing behavioral observation notes, generating adaptive stories according to immediate needs in the role-play center, composing thematic nasheed songs for the music center, visualizing stories via Gemini for the art center, and even suggesting backup activities when children suddenly become bored in the science center."*

   This statement illustrates integrated subdomains of AI applications, including personalization of spiritual tasks, behavioral analytics, contextual adaptive narratives, Islamic music composition, artistic visualization, and operational contingency planning. Collectively, these reflect multidimensional fluency encompassing cognitive, affective, and spiritual domains. Teacher Farida (March 11, 2026) reinforced this finding by explaining that AI provides on-demand fluency when classroom conditions change unexpectedly, such as generating interactive nasheed songs or personalized story visualizations within less than two minutes, thereby maintaining pedagogical momentum without disruption.

   Principal Yuni (March 13, 2026) added a managerial perspective: *"During implementation, AI is used for many daily activities… I regularly monitor classrooms to ensure alignment with the Merdeka Curriculum and integrated Islamic values."* This confirms that AI-driven fluency is both quantitative and qualitative, supported by institutional oversight.

2. **Flexibility (Multimodal and Situational Adaptation in Heterogeneous Center Settings)**

   Flexibility measures the ability to shift between categories of ideas adaptively in response to dynamic environmental conditions. Principal Yuni explained: *"When children are bored with science center activities such as water experiments, we immediately shift to movement-based block center activities or reflective gratitude practices in the art center using adaptive AI prompts."*

   Teacher Lilik described media flexibility, where AI-generated content can be transformed into interactive games, simulations, or personalized illustrated stories. Teacher Farida emphasized emotional adaptation and shifting activities based on children's affective responses, with AI serving as a rational system for analyzing patterns and suggesting appropriate transformations.


Figure 1. Examples of Learning Media Used

The adaptation matrix derived from data triangulation demonstrates systematic transitions across centers, ensuring continuity of learning objectives while maintaining engagement.

3. **Originality: Personal and Contextual Innovation through the "AI Mirror of Akhlak"**

   Originality evaluates the uniqueness of ideas compared to conventional practices. The "AI Mirror of Akhlak" concept represents a paradigm shift in personalized learning. Principal Yuni stated: *"Children's stories are collected from daily observations and processed through AI to generate contextually relevant Islamic moral narratives."*

   Teacher Farida highlighted that each child receives a unique learning experience tailored to their psychological development, significantly increasing engagement. Teacher Lilik implemented practical activities in the science center through personalized Islamic quests that integrate Qur'anic values.

Figure 2. Implementation of Learning in the Preparation Center

This innovation reflects a shift from mass learning to personalized, data-driven learning trajectories integrating moral and experiential dimensions.

4. **Elaboration in Technical, Pedagogical, and Ethical Depth**
   Elaboration reflects the depth of idea development across multiple dimensions. The implementation demonstrates layered integration, including prompt engineering, alignment with BCCT, verification of Islamic content, screen-time regulation, data anonymization, and ethical validation.
   Principal Yuni emphasized institutional control, limiting AI use to fifteen minutes per session. Teacher Lilik highlighted greater pedagogical autonomy, while Teacher Farida stressed ethical safeguards, such as parental consent and validation by authoritative Islamic sources.

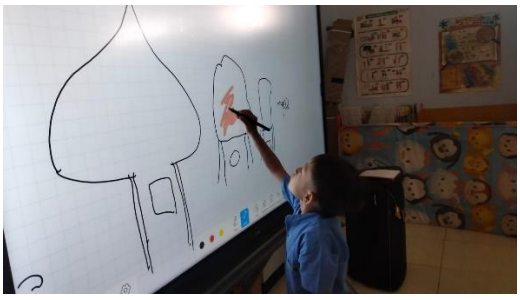

Figure 3. Integration of AI Use in Arts Centers

These practices ensure that AI integration remains aligned with educational, ethical, and religious principles.

5. **Evaluation (Continuous Assessment and Contextual Improvement Cycle)**
   Evaluation involves empirical validation through observation, assessment rubrics, portfolios, and weekly reflection forums. Principal Yuni noted increased student enthusiasm and improved teacher efficiency. Teacher Lilik focused on emotional responses, while Teacher Farida measured improvements in interaction quality and attention span.
   Overall findings indicate significant positive impacts, including increased enthusiasm, greater variation in learning activities, and improved efficiency. Challenges such as

technological dependency and potential inaccuracies in AI outputs are addressed through training, manual verification, and collaboration with parents, ensuring that AI integration remains effective under strict pedagogical supervision grounded in integrated Islamic educational values.

**Evaluation of Center-Based Learning with the Utilization of Artificial Intelligence (AI) at PG-TKIT 2 Qurrota A'yun Ponorogo**

The evaluation of AI-based center learning at PG-TKIT 2 Qurrota A'yun Ponorogo implements an integrated, continuous formative and summative assessment paradigm grounded in the *Beyond Centers and Circle Time* model, which emphasizes multi-source data triangulation. This includes field observations, children's developmental portfolios, analysis of learning artifacts, reflective teacher interviews, and collaborative weekly evaluation forums. Artificial intelligence systems such as ChatGPT-4o and Google Gemini function not only as instructional content generators but also as advanced analytical instruments that measure the effectiveness of teachers' divergent creativity through the indicators of fluency, flexibility, originality, elaboration, and evaluation, as conceptualized by Torrance and Guilford. Findings from in-depth interviews conducted between March 9–13, 2026, supported by longitudinal observation and document analysis, reveal a paradigm shift from conventional normative evaluation toward an adaptive, real-time data-driven system responsive to early childhood development within the framework of integrated Islamic education.

1. **Fluency: Multidimensional Analytical Capacity in Continuous Assessment**

   Fluency in the context of AI-based evaluation refers to teachers' ability to simultaneously and comprehensively generate diverse assessment instruments, criteria, and interpretations of children's developmental data. Principal Yuni (March 13, 2026) explained: *"Each AI-based lesson plan is evaluated through weekly forums using multiple instruments, including engagement rubrics in science and block centers, spiritual response checklists in the nature center, portfolio analysis in art and role-play centers, and cross-center observations to measure competency achievement aligned with the Merdeka Curriculum and the values of the Prophet's trustworthiness."*

   Teacher Lilik (March 9, 2026) added: *"I use AI to analyze children's behavioral observation data in real time across centers, including quantifying social interaction in role-play, mapping creative expression in art through drawing patterns, evaluating scientific understanding through Islamic daily quests, and measuring spiritual engagement through voluntary gratitude prayers."* Teacher Farida (March 11, 2026) further emphasized that AI can generate adaptive evaluation formats, such as interactive nasheed-based quizzes, personalized reflective journals, and narrative analyses of role-play activities, to assess children's understanding of moral values.

   These findings demonstrate that AI-driven evaluative fluency enables the simultaneous generation of multidimensional assessment tools across cognitive, affective, psychomotor, and spiritual domains, significantly enriching evaluation data and supporting precise pedagogical decision-making.

2. **Flexibility: Adaptation of Assessment Instruments to Developmental Heterogeneity**

   Evaluative flexibility refers to teachers' ability to adapt assessment instruments and strategies to children's developmental variability, learning modes, and situational contexts. Teacher Lilik illustrated this: *"Assessment instruments are adjusted to children's characteristics: for active kinesthetic learners in the block center, I use movement video analysis and focus duration observation, while for reflective learners in the art center, I use drawing journals and AI-generated structured interviews with personalized questions."*

   Principal Yuni highlighted multimodal evaluation: *"Face-to-face learning uses direct observation and physical portfolios, hybrid learning utilizes video recordings and digital checklists, and online learning relies on AI interaction logs and adaptive quizzes that adjust difficulty based on children's responses."* Teacher Farida added thematic adaptation, tailoring spiritual assessment according to cognitive stages—from imitation-based observation to reflective AI-generated responses.

   This adaptability aligns with Vygotsky's Zone of Proximal Development, with AI acting as an adaptive mediator that precisely maps children's actual and potential developmental levels.

3. **Originality: Innovative and Contextualized Evaluation Instruments**

   Originality in evaluation refers to the development of unique and context-sensitive assessment tools beyond conventional templates. At PG-TKIT 2 Qurrota A'yun, this is realized through the evaluative version of the *"AI Mirror of Akhlak."* Principal Yuni explained: *"We developed an 'AI Akhlak Progress Tracker' that analyzes children's weekly portfolios across centers to generate personalized narratives of moral development."*

   Teacher Farida noted that each child receives an individualized *Akhlak Development Map* integrating data from multiple centers, enabling targeted intervention. Teacher Lilik added that AI produces a *Science–Akhlak Correlation Report* linking scientific understanding with character values such as patience and trustworthiness.

   This innovation represents a synthesis between data-driven assessment and Islamic moral education, enabling evaluation not only of cognitive achievement but also of personal character transformation.

4. **Elaboration: Depth of Data Analysis and Multi-Source Triangulation**

   Elaboration in evaluation measures the depth of data analysis, the integration of multiple sources, and the contextual interpretation. Teacher Lilik described a multidimensional process in which observational data are analyzed by AI to quantify social interactions, evaluate creative patterns, correlate scientific understanding with behavioral traits, and map spiritual development.

   Principal Yuni emphasized institutional triangulation: *"Evaluation integrates five data sources: teacher observations, child portfolios, AI analysis, parental feedback via*

*WhatsApp groups, and collaborative teacher discussions, with AI synthesizing all inputs into a 'Comprehensive Child Development Profile.'"* Teacher Farida stressed the importance of ethical validation, ensuring alignment with the Merdeka Curriculum and Islamic values through manual verification.

This elaboration creates a robust, multidimensional evaluation cycle in which AI enhances analytical depth without replacing professional teacher judgment.

5. **Evaluation: Meta-Evaluation of AI-Based Assessment Effectiveness**

Meta-evaluation assesses the effectiveness of the evaluation system itself. Principal Yuni concluded: *"Weekly evaluation forums show that the AI system increases children's learning enthusiasm, enhances the variety and contextual relevance of materials, and improves teacher efficiency in planning remedial and enrichment interventions."*

Teacher Lilik highlighted increased emotional engagement and early detection of learning barriers, while Teacher Farida confirmed improved social interaction and more precise mapping of children's social development.

Identified challenges include potential over-reliance on AI outputs, the need for parental digital literacy, and limited access to devices at home. These are addressed through blended learning strategies, manual verification, and parent collaboration. Overall, all informants agree that the benefits of AI-based evaluation significantly outweigh operational challenges when implemented under strict pedagogical supervision grounded in integrated Islamic educational values.

### 3.2. Discussion

**Learning Center Planning with the Utilization of Artificial Intelligence (AI) at PG-TKIT 2 Qurrota A'yun Ponorogo**

The implementation of artificial intelligence (AI)-based center learning at PG-TKIT 2 Qurrota A'yun Ponorogo integrates empirical interview findings into the theoretical framework of divergent creativity proposed by E. Paul Torrance and J. P. Guilford, with the indicators of fluency, flexibility, originality, elaboration, and evaluation serving as the primary analytical lenses. This framework reveals a transformation in pedagogical paradigms within integrated Islamic early childhood education. AI systems such as ChatGPT-4o and Google Gemini function as real-time operational supports, enabling teachers to transcend conventional creative limitations and implement center-based learning that is responsive to the Beyond Centers and Circle Time model through the optimization of play intensity and density as a methodological foundation of early childhood education.

The fluency aspect of implementation at PG-TKIT 2 Qurrota A'yun reflects the cognitive ability to generate diverse pedagogical supports simultaneously during classroom dynamics. This is demonstrated through AI applications in daily Islamic missions within IMTAQ centers, instant behavioral analysis in role-play centers, adaptive storytelling in role-play centers, nasheed composition in music centers, visual storytelling via Gemini in art centers, and contingency activity suggestions in science centers when boredom is

detected. This manifestation of fluency encompasses eight integrated subdomains, including spiritual quest personalization, behavioral analytics, contextual narrative generation, Islamic music composition, artistic visualization, and operational contingency planning, collectively enriching the play density within the BCCT framework.

These findings correspond with prior research by [16], which identified that AI tools such as ChatGPT and Canva AI enhance teachers' inspiration in designing lesson plans and Islamic-adaptive learning media. However, the PG-TKIT 2 Qurrota A'yun context offers a unique dimension through center-specific integrations, such as IMTAQ-based activities, Qur'anic calligraphy art, and simulations of ethical marketplaces, extending beyond the scope of earlier studies. The parallel-processing capability of AI aligns with Guilford's Structure of Intellect, reducing cognitive load and allowing teachers to focus on scaffolding heterogeneous developmental needs across centers.

Flexibility in implementation is reflected in teachers' ability to adapt strategies in response to changing classroom conditions, student responses, and learning modalities. For example, science center exploration may be shifted to gross motor activities in the block center or reflective gratitude practices in the IMTAQ center through adaptive AI prompting. Online learning media, such as AI-generated videos, can be transformed into interactive role-play games or visual storytelling for less active children, ensuring differentiation based on Lev Vygotsky's zone of proximal development. Emotional adjustments are also evident, such as transitioning from high-energy block activities to contemplative Qur'anic calligraphy in art centers.

These findings align with the study by [17], which highlights AI's role in enhancing professional competence, enabling personalized learning, and automating routine tasks to foster creativity. The PG-TKIT 2 Qurrota A'yun context extends this by incorporating ethical-religious dimensions within Islamic education. Real-time decision-making supported by AI functions as an efficient decision support system, bridging dynamic center activities with child-centered learning while maintaining optimal play intensity and accommodating developmental diversity.

Originality in implementation is embodied in the concept of the "AI Mirror of Akhlak," where children's observed behaviors in learning centers are processed into personalized Islamic narratives that model moral exemplars. For instance, a child's fear of darkness may be addressed through a story inspired by the Prophet's courage, tailored to the child's psychological and developmental context. This approach differs fundamentally from generic storybooks, offering personalized learning experiences that enhance engagement and relevance. Similarly, personalized Qur'anic-based science quests, such as water-cycle exploration, demonstrate a shift from traditional, non-adaptive teaching to individualized learning trajectories. This reflects a transformation from mass instruction to personalized character development grounded in Islamic values.

This finding complements [18], which emphasizes the role of platforms such as Canva and Powtoon in enhancing interactive learning media despite technical constraints. The PG-TKIT 2 Qurrota A'yun context extends this by integrating moral (akhlak) dimensions and addressing technical challenges through continuous collaborative training. The "AI Mirror of Akhlak" makes a methodological contribution by connecting

technological personalization with character transformation, enriching the literature on hybrid Islamic-digital learning models and validating the originality dimension of Torrance's framework in AI-supported early childhood education.

Elaboration in implementation reaches a comprehensive level encompassing technical, pedagogical, and ethical dimensions. This includes limitations on screen time, direct supervision, alignment with the Kurikulum Merdeka, and adherence to integrated Islamic educational principles. Teachers maintain autonomy to focus on emotional and spiritual interactions, while AI supports content personalization. Challenges such as data security are addressed through anonymization protocols and manual verification of AI outputs. AI is positioned as a supportive tool rather than a replacement for moral and ethical teaching (adab), with strict prohibitions on the use of personal data without parental consent and mandatory validation against primary Islamic sources.

Evaluation in implementation demonstrates a continuous and comprehensive assessment process, including classroom observation, activity monitoring, weekly teacher forums, and indicators such as student enthusiasm, content variation, and time efficiency. Children's emotional responses and engagement levels are assessed through checklists and video recordings, enabling early detection of learning barriers and consistent behavioral patterns. Social interactions, such as discussions on moral values, role-playing, and artistic expression, are mapped to provide precise insights into socio-emotional development and improvements in attention span. Despite challenges such as potential over-reliance on AI outputs, the need for manual verification, and limited parental digital literacy, strategies such as blended learning and strengthened parental involvement are implemented.

**Implementation of Center-Based Learning Using Artificial Intelligence (AI) at PG-TKIT 2 Qurrota A'yun Ponorogo**

The implementation of AI-based center learning at PG-TKIT 2 Qurrota A'yun Ponorogo integrates empirical findings from interviews into the theoretical framework of divergent creativity proposed by E. Paul Torrance and J. P. Guilford. The indicators of fluency, flexibility, originality, elaboration, and evaluation serve as the primary analytical lenses in revealing a transformation of pedagogical paradigms within integrated Islamic early childhood education. AI systems such as ChatGPT-4o and Google Gemini function as real-time operational supports that enable teachers to transcend conventional creative limitations. This results in center-based practices that are responsive to the Beyond Centers and Circle Time model by optimizing play intensity and density as a methodological foundation of early childhood education. The comparison of local findings with prior studies highlights the unique contribution of the Ponorogo context to contemporary empirical literature, with significant theoretical, practical, and contextual implications for the integration of advanced technology in Islamic educational ecosystems.

The fluency dimension of implementation reflects teachers' cognitive ability to generate multiple forms of pedagogical support simultaneously during classroom dynamics. This is evident in the application of AI for personalized Islamic daily missions in IMTAQ centers, instant behavioral analysis in role-play centers, adaptive storytelling in role-play centers, nasheed composition in music centers, AI-generated visual storytelling in

art centers, and contingency activity suggestions in science centers when boredom is detected. This manifestation of fluency encompasses integrated subdomains such as spiritual quest personalization, behavioral analytics, contextual narrative generation, Islamic music composition, artistic visualization, and operational contingency planning, all of which enhance the density of play within the BCCT framework. On-demand fluency, such as generating interactive nasheeds or personalized visual stories in under two minutes, ensures alignment with learning objectives grounded in Islamic values without disrupting pedagogical momentum, and is supported by institutional alignment with the Kurikulum Merdeka.

18 These findings align with prior research by Dinata et al. (2025), which found that AI tools enhance teachers' creativity in lesson planning and in the development of Islamic-adaptive learning media. However, the PG-TKIT 2 Qurrota A'yun context contributes a unique dimension through center-specific integration, including IMTAQ-based activities, Qur'anic calligraphy, and ethical marketplace simulations, thereby extending beyond previous findings. The parallel-processing capability of AI aligns with cognitive principles described by Guilford's Structure of Intellect, reducing cognitive load and enabling teachers to allocate more cognitive resources to scaffolding diverse developmental needs across learning centers.

Flexibility in implementation is demonstrated through the ability to adapt instructional strategies in response to changing classroom conditions, student behavior, and learning modalities (offline, online, and hybrid). For instance, science center exploration may be shifted to gross motor activities in the block center or reflective gratitude practices in the IMTAQ center through adaptive AI prompts. AI-generated digital media can be transformed into interactive role-play scenarios or visual storytelling to engage less active children, thereby ensuring differentiation aligned with Lev Vygotsky's zone of proximal development. Emotional adaptation is also evident, as seen in transitioning from high-energy physical activities to contemplative Qur'anic calligraphy in art centers. AI functions as an analytical system that identifies behavioral patterns and recommends targeted instructional adjustments, thereby supporting dynamic, child-centered learning environments.

These findings are consistent with the study by [17], which emphasizes AI's role in enhancing professional competence, enabling personalized learning, and automating routine tasks. The PG-TKIT 2 Qurrota A'yun context extends these findings by incorporating ethical and religious dimensions within Islamic education. AI-supported real-time decision-making acts as an efficient decision support system that bridges dynamic center activities with child-centered learning while maintaining optimal play intensity and accommodating developmental diversity.

Originality in implementation is reflected in the innovative concept of the "AI Mirror of Akhlak," which processes children's observed behaviors into personalized Islamic narratives that model moral values. For example, a child experiencing fear of darkness may receive a contextualized story inspired by prophetic courage, tailored to their psychological and developmental condition. This approach differs fundamentally from generic storytelling, offering personalized learning experiences that enhance engagement

and relevance. Similarly, personalized Qur'anic-based science activities, such as water-cycle exploration integrated with Islamic teachings, demonstrate a shift from traditional, non-adaptive instruction toward individualized learning trajectories that integrate cognitive development with character formation.

This finding complements research by [18], which identified that digital platforms enhance creativity in learning media despite technical limitations. The PG-TKIT 2 Qurrota A'yun context advances this by integrating moral (akhlak) dimensions and addressing technical challenges through continuous collaborative training. The "AI Mirror of Akhlak" makes a methodological contribution by connecting technological personalization with character development, enriching the literature on hybrid Islamic-digital learning models.

The evaluation dimension of implementation reflects a continuous assessment process involving classroom observation, activity monitoring, weekly teacher forums, and indicators such as student enthusiasm, content diversity, and time efficiency. Children's emotional responses and engagement are assessed through checklists and video recordings, enabling early detection of learning barriers and consistent behavioral patterns. Social interactions such as discussions of moral values, role-play activities, and artistic expression are systematically mapped to provide precise insights into socio-emotional development and attention span improvement.

Despite challenges such as potential over-reliance on AI outputs, the need for manual verification, and limited parental digital literacy, these issues are addressed through blended learning strategies and collaborative training. Overall, the benefits of AI integration in the implementation phase significantly outweigh the operational challenges, provided that strong pedagogical supervision grounded in integrated Islamic educational values is maintained.

**Evaluation of Center-Based Learning Using Artificial Intelligence (AI) at PG-TKIT 2 Qurrota A'yun Ponorogo**

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The evaluation of AI-based center learning at PG-TKIT 2 Qurrota A'yun Ponorogo integrates empirical findings from in-depth interviews into the theoretical framework of divergent creativity proposed by E. Paul Torrance and J. P. Guilford. The five indicators fluency, flexibility, originality, elaboration, and evaluation serve as the primary analytical lenses to examine the transformation of integrated formative and summative assessment paradigms within Islamic early childhood education. This system is responsive to the Beyond Centers and Circle Time model through multi-source triangulation, including classroom observations, child development portfolios, analysis of learning artifacts, reflective teacher interviews, and weekly collaborative evaluation forums, forming a holistic methodological foundation for early childhood education.

AI systems such as ChatGPT-4o and Google Gemini function not only as instructional content generators but also as advanced analytical tools that enable teachers to move beyond conventional normative evaluation toward adaptive, real-time, data-driven assessment systems aligned with the Kurikulum Merdeka and integrated Islamic values. A comparison of local findings with prior studies reveals the unique contribution of the Ponorogo context to contemporary empirical literature, with significant theoretical,

practical, and contextual implications for the integration of advanced technology within an evolving Islamic educational ecosystem.

Fluency in evaluation reflects teachers' cognitive ability to simultaneously and comprehensively generate diverse assessment instruments, criteria, and interpretations of children's developmental data. This enables a holistic mapping of developmental achievements across all learning centers with high efficiency, supported by structured weekly forums utilizing engagement rubrics in science and block centers, spiritual response checklists in IMTAQ centers, portfolio analysis in art and role-play centers, and cross-center observations aligned with the competencies of the Kurikulum Merdeka and Islamic values. AI facilitates real-time behavioral analysis, quantification of social interactions in macro- and micro-scale role-play centers, mapping of creative expression in art centers, evaluation of scientific understanding through Islamic daily quests, and measurement of spiritual engagement, such as voluntary expressions of gratitude. Adaptive evaluation formats—including interactive quizzes, nasheed-based assessments, personalized reflective journals, and narrative analysis of role-play dialogues—capture cognitive, affective, psychomotor, and spiritual domains simultaneously. This evaluative fluency extends beyond quantitative instrumentation to qualitative interpretation enriched by AI's parallel processing capabilities, reducing cognitive load as conceptualized in Guilford's Structure of Intellect and allowing teachers to focus on differentiated scaffolding across centers.

Flexibility in evaluation is demonstrated through the adaptive use of assessment instruments and strategies in response to variations in child development, learning modalities (face-to-face, hybrid, and online), and contextual dynamics. Instruments are tailored to children's characteristics; for example, kinesthetic learners in block centers are assessed through movement video analysis and observation of attention duration, while reflective learners in art centers are evaluated through drawing journals and structured AI-assisted interviews. Multimodal evaluation approaches, including direct observation, physical portfolios, digital checklists, AI interaction logs, and adaptive quizzes that adjust difficulty based on prior responses, ensure precise differentiation aligned with Lev Vygotsky's zone of proximal development. Spiritual assessment in IMTAQ centers evolves from observing imitative behaviors to reflective understanding supported by AI-generated prompts, ensuring valid and reliable evaluation across heterogeneous developmental stages within child-centered BCCT environments.

Originality in evaluation is reflected in the development of innovative, context-specific assessment instruments that go beyond conventional templates. These include the "AI Akhlak Progress Tracker," which analyzes weekly portfolios across centers to generate personalized narratives of moral development; the "Akhlak Development Map," which integrates data from art, music, and IMTAQ centers to track the internalization of Islamic values; and the "Science-Akhlak Correlation Report," which links scientific exploration, such as the water cycle with values like patience and responsibility. These tools represent a creative synthesis of cognitive and moral assessment, reflecting a shift toward personalized, context-based evaluation systems that integrate advanced analytical capabilities with character development.

Elaboration in evaluation is demonstrated through the depth of data analysis and integration of multi-source information. Observational data from learning centers are processed through AI systems for multidimensional analysis, including quantification of social interactions, assessment of creative expression, correlation of scientific understanding with moral values, and mapping of spiritual engagement. Institutional triangulation involves five primary data sources: teacher observations, child portfolios, AI analytics, parental feedback (e.g., via digital communication platforms), and weekly collaborative discussions. AI functions as a meta-analytical tool synthesizing these data into outputs such as the "Comprehensive Child Development Profile," which supports parent-teacher conferences. All analyses are subject to manual validation against the Kurikulum Merdeka and authoritative Islamic references to ensure alignment with integrated educational values. This multidimensional evaluation process enhances professional judgment while adhering to ethical AI principles.

The evaluation dimension further encompasses meta-evaluation of system effectiveness in achieving learning objectives and supporting child development. Weekly forums supported by AI systems assess indicators such as student engagement, diversity of learning materials, contextual relevance, and efficiency in planning remedial and enrichment interventions. Emotional responses, participation in reflective and creative activities, early detection of learning barriers, and consistent behavioral patterns are systematically monitored. Social interactions such as moral discussions, role-play, and artistic collaboration are mapped to provide precise insights into socio-emotional development and attention span improvement.

The findings from PG-TKIT 2 Qurrota A'yun Ponorogo enrich the literature on teacher creativity and AI integration within the unique context of integrated Islamic early childhood education. This study extends prior research by demonstrating holistic integration across learning centers, ethical-religious dimensions, and multidimensional personalization of moral development. Theoretically, it validates the divergent creativity model of Torrance and Guilford within an AI-supported Islamic ECE context. Practically, it offers policy recommendations for replicating hybrid AI-based learning models in similar institutions, including teacher and parent digital literacy training and the development of blended learning infrastructure. Future research is recommended to involve multi-site comparative studies and longitudinal designs to examine the long-term impacts on character development and to validate further innovations such as the "AI Mirror of Akhlak."

## 5. CONCLUSION

This study affirms that integrating artificial intelligence in center-based early childhood learning reshapes how teachers construct, adapt, and evaluate learning processes. Rather than functioning as a mere technical aid, AI serves as a cognitive and pedagogical enabler, strengthening creative teaching practices and supporting more responsive, child-centered learning environments grounded in developmental and value-based principles. From an implication perspective, the findings highlight the need to reposition teachers as reflective designers who strategically use AI to enhance instructional

quality rather than replace professional judgment. For educational institutions, this underscores the importance of investing in digital competence, structured supervision, and ethical guidelines to ensure that technology integration remains pedagogically meaningful and contextually appropriate. However, this research is bounded by its focus on a single institutional context with a qualitative design, limiting generalizability across different educational settings. The reliance on specific AI platforms and their integration within a particular cultural-religious framework also constrains broader applicability without contextual adaptation.

Future studies are recommended to adopt comparative and longitudinal approaches to examine sustained impacts on children's cognitive, socio-emotional, and character development. Further exploration is also needed to assess scalability across diverse early childhood institutions and to refine AI-supported pedagogical models. For the broader public, this research demonstrates that AI, when guided by ethical and educational principles, can enhance learning quality, support teacher professionalism, and foster more adaptive and inclusive early childhood education systems.

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