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The Role of Artificial Intelligence (AI) Technology in the Development of Early English Teaching Materials

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ABSTRACT

English has long been recognized as the dominant international language in various aspects of global life, from international communication and higher education to mastery of technology and science. The purpose of this study is to explore the role of AI in developing early English language teaching materials and identify its opportunities and challenges in early childhood education. This research method uses a quantitative approach. The sample of this study included 10 teachers at TKIT Model Madani Arrahman Pekanbaru City. The results show that teachers at TKIT Model Madani Arrahman Pekanbaru have sufficient initial knowledge of AI technology, although it is still limited to general use and has not been fully directed at developing teaching materials. AI is considered to play a role in helping teachers create more varied, interesting, and enjoyable English teaching materials for early childhood. However, the implementation of AI still faces technical obstacles, limited resources, and the need to adapt content to the characteristics of early childhood. Thus, AI has great potential in supporting the development of early childhood English teaching materials, but it needs to be supported by training, infrastructure, and strengthening teacher capacity for optimal and contextual implementation.

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1. INTRODUCTION

English has long been recognized as the dominant international language in various aspects of global life, ranging from communication between nations, higher education, to the mastery of technology and science. This strategic position makes mastering English a crucial skill for future generations. Therefore, the introduction of English from an early age is not only optional but has become a necessity in order to form children's initial competencies in facing the era of globalization and the development of digital civilization (García Mayo, 2021). Early Childhood Education (ECE) is a very fundamental stage because it is during this time that children experience rapid language, cognition,

social, and emotional development. Therefore, English language learning at the early childhood stage must be carefully designed and implemented using developmentally appropriate practices (DAP) that are aligned with the unique cognitive, linguistic, socio-emotional, and physical characteristics of young learners. This is crucial because early childhood (ages 0–8) represents a sensitive period in which the brain is highly plastic and responsive to environmental stimuli, including language exposure (UNESCO, 2021; Aronin & Singleton, 2021). At this stage, children do not learn in abstract or linear ways like older students. Instead, they learn best through play, exploration, interaction, and sensory-rich experiences, which must be reflected in the design of English language learning materials and strategies.

According to Jean Piaget's theory of cognitive development, children in early childhood are typically in the preoperational stage (ages 2–7), where they think symbolically but are still developing the ability to use logic and understand complex abstract concepts. Thus, English learning activities should incorporate concrete objects, visual aids, and contextualized experiences that connect language to real-life situations and meaningful routines (Piaget, in Berk & Meyers, 2020). For example, using songs, storytelling, picture books, puppets, and dramatic play can help children acquire new vocabulary and develop listening and speaking skills in English naturally and joyfully. In addition, Lev Vygotsky's sociocultural theory emphasizes that children learn language through social interaction within their "Zone of Proximal Development" (ZPD), where guidance from more capable peers or adults supports learning that the child could not achieve independently. In this context, English language instruction should encourage collaborative and dialogic learning, with teachers acting as facilitators who scaffold children's understanding through interaction, repetition, modeling, and encouragement (Vygotsky, in Daniels, 2022). Peer communication, cooperative games, and teacher-child dialogues in English are essential components of an effective early language learning environment. Furthermore, the principles of Developmentally Appropriate Practice (DAP) as outlined by the National Association for the Education of Young Children (NAEYC) highlight the importance of aligning teaching approaches with children's developmental stages, individual differences, and cultural backgrounds (Copple & Bredekamp, 2021). This means that early English learning should not impose rigid academic drills or grammar rules, but rather focus on immersive, play-based, and emotionally supportive learning experiences that respect the way young children construct meaning from their world.

Recent studies have supported these theoretical perspectives. García Mayo (2021) and Cenoz & Gorter (2020) stress that early exposure to a second language such as English must be contextualized, playful, and emotionally engaging to be effective. Similarly, Daniel (2020) found that young children show greater motivation and retention when English is introduced through interactive media, games, music, and stories, rather than through formal instruction. In line with this, the integration of digital and AI-based technologies when used in age-appropriate ways can support these pedagogical principles by providing interactive, visual, and multisensory learning experiences tailored to the needs and attention spans of young learners (Holmes et al., 2022; Wang et al., 2023). However, the implementation of English language learning at the ECE level is faced with challenges that are not simple. One of the main obstacles is the limited teaching materials that can adapt to children's learning styles, as well as the lack of media that can really attract their attention and maintain their concentration. Young children have a short attention span and need visual stimulation and concrete activities to learn optimally. Therefore, we need teaching materials that are not only educational, but also fun, interactive, and in accordance with their developmental stages (Nikolopoulou, Gialamas, & Tsitouridou, 2021).

To address these challenges, one innovative approach that is rapidly growing is the utilization of Artificial Intelligence (AI) technology in the development of teaching materials. This technology allows the development of content that is not static, but dynamic and adaptive to the needs of each child. AI plays an important role in creating personalized learning, where the system can automatically recognize learning preferences, difficulties faced, and learning styles of learners through analysis of data collected during the learning process. Thus, children are not just passive recipients but can be

actively engaged and tailored to their unique needs (Levy & Stockwell, 2006; Holmes et al., 2022). In addition, AI is also able to provide real-time feedback that is constructive, thus supporting a continuous and reflective learning process (Zawacki-Richter et al., 2020). Another advantage of AI technology in early childhood English language learning is its ability to present multimedia learning content. Young children respond strongly to visual, sound and movement stimulus. In this case, AI supports the integration of elements such as animation, interactive narration, video, and educational games that are not only visually appealing, but also strengthen children's understanding and recall of vocabulary and language structures (Sánchez-Prieto, Olmos-Migueláñez, & García-Peñalvo, 2017; Daniel, 2020). Research shows that AI-based multimedia approaches significantly increase the effectiveness of second language learning in children, especially in the context of repetition, interaction, and high emotional engagement (Yin et al., 2022).

In addition, various digital platforms that implement AI technology also provide advanced learning facilities such as conversation simulation, automatic phonetic exercises, and live mispronunciation detection and correction. This allows children to gain language learning experiences that resemble natural contexts or real-life situations, albeit in a limited environment (Colpaert, 2004; Healey & Jenkins, 2009; Kukulska-Hulme, 2020). Such an approach is certainly more beneficial than conventional methods that tend to be one-way and less responsive to individual needs. However, the realization of the application of AI in the context of ECE is not entirely without obstacles. Structural challenges such as limited technological infrastructure, lack of hardware and software support, and availability of internet access are major obstacles, especially in schools that do not have adequate facilities. In addition, the readiness of educators is also an important issue. Many PAUD teachers are not familiar with AI technology and have not received relevant training on its utilization in the teaching process. As a result, the innovations offered by these technologies have not been fully integrated optimally in daily learning practices. (Luckin, Holmes, Griffiths, & Forcier, 2021; Zhai, Chu, & Wang, 2021).

Considering the urgency and great potential of AI technology in improving the quality of English language learning in early childhood, it is very important to conduct a systematic and contextual study. This research aims to examine in depth how AI technology can play a role in the development of relevant, effective and fun teaching materials. Not only that, but this research is also directed to identify opportunities and obstacles that arise in the implementation process in educational units, especially in TKIT Madani Arrahman Model Pekanbaru City. Through this study, it is hoped that a thorough understanding of the dynamics of the application of AI technology in the development of early English teaching materials can be obtained. Thus, the results of this study are expected to provide theoretical and practical contributions, as well as the basis for policy making and the development of PAUD teacher training programs in utilizing smart technology for the benefit of children's education in the digital era.

The purpose of this research is to explore the role of AI in developing early English language learning materials and identify its opportunities and challenges in early childhood education. It is hoped that this research will demonstrate that AI has significant potential to support the development of early childhood English language learning materials. However, it needs to be supported by training, infrastructure, and teacher capacity building for optimal and contextual implementation.

2. METHOD

This research is a descriptive quantitative study that aims to describe teachers' perceptions of the use of digital learning media in early English language learning for young children. Quantitative descriptive research is used to describe or describe a phenomenon systematically and factually without looking for relationships or comparisons between variables (Sugiyono, 2018). The main variable in this study is teachers' perceptions of the utilization of digital learning media in the context of teaching English in early childhood. The research was conducted at TKIT Madani Arrahman Model Pekanbaru City during the period October 2024 to July 2025. The population in this study were all teachers who

taught at TKIT Model Madani Arrahman Pekanbaru City. The sampling technique used was total sampling, namely the entire population was sampled, with a total of 10 teachers. Data collection was carried out through the distribution of closed questionnaires designed to measure teacher perceptions related to aspects of usefulness, ease of use, and effectiveness of digital media in learning English. The data collected were analyzed quantitatively descriptively using simple statistical techniques in the form of frequency distribution and percentage to describe the tendency of respondents' perceptions of the use of digital media in learning.

3. FINDINGS AND DISCUSSION

The main focus in this section is to examine the extent to which AI plays a role in supporting the process of planning, creating, and implementing teaching materials that are appropriate for early childhood characteristics. In addition, this analysis also includes the forms of implementation that teachers have tried, their perceptions of the effectiveness of using AI, and the obstacles faced in practice. Based on the results of the data processing that has been carried out, the results of the research on teachers' initial knowledge of AI are as follows:

Tabel.1. Results of Questionnaire on Teachers' Prior Knowledge of AI

Statement	Strongly Agree (%)	Agree (%)	Disagree (%)	Disagree (%)
Understanding AI technology	40	20	30	10
AI is in line with the needs of digital education	0	50	10	40
AI is useful for developing teaching materials	40	0	0	60

The results of the questionnaire show that most teachers at TKIT Model Madani have a fairly good understanding of Artificial Intelligence (AI) technology. They are generally familiar with AI concepts through daily use of digital applications such as Google Translate, predictive text features, and design platforms like Canva. However, this understanding tends to remain at a general level and has not yet been internalized in a way that enables its pedagogical application particularly in the development of teaching materials that are aligned with the developmental characteristics of early childhood learners. In relation to the relevance of AI to current digital education needs, several teachers acknowledged that technology integration is a necessity in today's learning environment. They view AI as part of the broader transformation of education in the digital era. However, this perspective is not yet universally shared. Some teachers expressed skepticism about its effectiveness in the TKIT setting due to infrastructural challenges, including unstable internet connections, limited access to digital devices, and a lack of technical training. These barriers contribute to the uneven and suboptimal implementation of AI across classrooms. While a number of teachers have begun experimenting with AI tools such as using ChatGPT to create English learning stories or composing educational songs—many others remain unconvinced of their benefits. A key barrier identified is that AI-generated content is often too generic, lacking contextual sensitivity and requiring significant adaptation to align with Islamic values, local culture, and the specific cognitive needs of 5–6-year-old children. In a TKIT environment, where the integration of spiritual, moral, and character education is fundamental, generic content may not only be insufficient but potentially inappropriate.

Moreover, not all teachers felt confident or competent enough to modify AI-generated content into appropriate teaching materials. This is largely due to the fact that AI content is not inherently designed based on early childhood pedagogical principles, which prioritize simplicity, concreteness, emotional engagement, and developmental relevance. Teachers must possess not only subject matter expertise

but also the ability to adapt language, visuals, and instructional formats to suit the attention span and emotional readiness of young learners. This level of customization requires a unique combination of digital literacy, pedagogical knowledge, and creative instructional design, which many teachers have not yet acquired. The lack of training, limited exposure to best practices, and absence of mentoring mechanisms have further contributed to teachers' hesitation in engaging with AI tools. In addition, the lack of contextual guidance on how to integrate Islamic values into AI-generated content reinforces their concerns about cultural misalignment and instructional appropriateness. Thus, while AI holds considerable promise in enhancing the development of English language teaching materials for early childhood learners, its effective implementation is still constrained by issues of teacher preparedness, technical infrastructure, and capacity for contextual adaptation. These findings highlight the urgent need for institutional support in the form of structured professional development programs, ongoing digital pedagogy training, and collaborative resource development initiatives. Only through such efforts can the potential of AI be maximized to support meaningful, culturally responsive, and developmentally appropriate learning in TKIT settings.Furthermore, the results of Artificial Intelligence (AI) Technology plays a role in the Development of Early English Teaching Materials at TKIT Madani Arrahman Model Pekanbaru City are also explained, as follows:

Tabel 2. Questionnaire Results of AI's Role in Early English Teaching Material Development

Aspects of the Role of AI	Indicator Statements	Strongly Agree (%)	Agree (%)	Disagree (%)	Disagree (%)
Content development tool	AI helps generate creative ideas	30	20	30	20
	AI accelerates the creation of teaching materials	20	40	20	20
Interactive learning media	Children are more interested in learning using AI-based media	40	30	20	10
	AI supports a joyful learning approach	20	30	30	20
Pedagogical transformation	Experienced technical problems in using AI	10	20	40	30
	Need further training related to the use of AI in learning	40	20	10	30

Based on the findings in the field, teachers at TKIT Madani Arrahman Model have high enthusiasm in developing teaching materials, especially those related to the introduction of English for early childhood. However, the implementation of Artificial Intelligence (AI) technology as part of the teaching material development process still faces various challenges. Some teachers have shown openness to the use of AI, especially in the context of finding inspiration for content such as short stories, children's songs, and educational games that support early English learning. This shows that AI plays a role as a tool in generating creative ideas and accelerating the process of designing teaching materials. However, not all teachers have equal access and skills in utilizing such technology. In terms of learning interaction, some teachers reported that the use of AI-based media can increase children's engagement in learning. Children become more enthusiastic when the material is delivered with the help of moving images, sounds, or automatic narration sourced from AI-based applications. This supports the concept of joyful learning that characterizes learning at TKIT Model Madani Arrahman Pekanbaru. However, in general, there are still significant obstacles in the field. Some teachers experience technical barriers, such as limited devices, unstable internet connections, and lack of training in the pedagogical use of AI. Teachers who are not familiar with technology tend to feel less confident to integrate AI into their teaching practice. In addition, since TKIT Model Madani is based on Islamic values, there is a particular need to modify or filter AI content to suit the vision and values of Islamic

education. Therefore, although AI has great potential in supporting the development of early English teaching materials, its optimal realization still requires institutional support in the form of periodic training, provision of adequate facilities, and strengthening digital literacy for teachers. A gradual and contextual approach is important so that technological innovation can truly be realized.

Early age is the golden age for children to learn language, learning English in early childhood is done as an introduction to language not as the main thing. Chistina (2010) states that children aged 3-6 years understand English the fastest if they are accustomed to using words or expressions in English. However, media is needed to support early English learning activities in the classroom. So that learning is carried out well and meaningful for early childhood, especially in the introduction of early childhood English. This study aims to describe how the initial knowledge of teachers and the role of Artificial Intelligence (AI) technology in the development of early English teaching materials at TKIT Madani Arrahman Model Pekanbaru City. Based on the questionnaire results and field findings, this discussion will be described in two main focuses that are in line with the problem formulation.

Teachers' Prior Knowledge of AI Technology

Based on the results of the data analysis, it is known that most teachers already have basic knowledge of Artificial Intelligence (AI) technology. This knowledge is generally gained from daily experience in using popular digital applications such as Google Translate, Canva, or automatic text prediction features on mobile devices and computers. However, this understanding is still practical and limited to the use of technology for general purposes, rather than in a more specific pedagogical context. This finding is in line with Teo's (2011) view, which states that teachers' mastery of technology (technological knowledge) is often not accompanied by the ability to integrate it effectively into the learning process. In the context of education, meaningful technology integration requires more than just the ability to use digital tools. This is emphasized in the Technological Pedagogical Content Knowledge (TPACK) framework developed by Mishra and Koehler (2006), which states that the effective use of technology in learning can only be achieved if teachers are able to integrate three aspects synergistically, namely technology, pedagogy and teaching content. Without a balanced understanding of all three, the utilization of AI will only stop at the stage of technical use, not learning transformation.

The facts on the ground show that teachers with digital or younger generation backgrounds show a higher level of confidence in exploring AI as a tool for developing English teaching materials. They are more open to trying AI-based platforms in creating interactive stories, educational songs, and vocabulary visualizations. Meanwhile, teachers who are not familiar with digital technology tend to show hesitation and lack of confidence, and express the need for more intensive training and mentoring. This phenomenon is supported by Howard, Tondeur, Ma, & Yang's (2021) study which found that age, technology experience, and access to professional training are important determinants in teachers' readiness to integrate technology in learning. Furthermore, research by Petko, Prasse, & Cantieni (2020) revealed that teachers' perceptions of the relevance and benefits of technology are strongly influenced by their level of prior knowledge. The better teachers' understanding of the function and potential of technology for instructional purposes, the higher their motivation to integrate it into learning. Therefore, teachers' prior knowledge of AI is not only an indicator of readiness, but also a crucial foundation in directing effective professional development strategies. Thus, it can be concluded that although most teachers are familiar with AI technology in their daily lives, its utilization in the context of English language learning for early childhood still requires strengthening from the pedagogical and technological sides. This confirms the importance of continuous training and capacity building for teachers within the TPACK framework for optimal, contextualized, and sustainable integration of AI in early childhood education.

The Role of AI Technology in Teaching Material Development

Further findings show that Artificial Intelligence (AI) technology plays an important role in supporting teachers to develop more varied, efficient and engaging English teaching materials for early

childhood. Teachers utilize AI to generate creative learning ideas, compose short stories, provide visual illustrations, and design educational activities that suit children's developmental characteristics. In this case, AI serves as a creative tool that accelerates the content production process and enriches the variety of learning media used in the classroom. Research by Huang et al. (2021) supports this finding by showing that AI can improve teachers' efficiency in designing teaching materials while simplifying the process of adapting materials for different levels of student ability. The use of AI allows teachers to customize content based on individual needs more quickly and flexibly. In line with this, Mayer's (2009) Multimedia Learning theory explains that early childhood tends to learn more effectively when materials are presented in the form of a combination of visual, audio, and text. Therefore, AI that can produce interactive learning media has the potential to significantly increase children's understanding and engagement. However, despite this potential, AI implementation is also faced with a number of practical challenges. Teachers at TKIT Model Madani Arrahman stated that infrastructure limitations, such as unstable internet access and inadequate devices, are still major obstacles. They also highlighted the urgent need for targeted technical and pedagogical training, so that the use of AI is not only mechanical but can also support the overall goals of early childhood education. This is reinforced by Jang (2021), who emphasized that the successful integration of AI in learning is highly dependent on institutional support as well as the sustainability of teacher professional development programs.

Furthermore, the use of AI in a value-based institution like TKIT also presents value and context challenges. Teachers expressed the need to filter the content generated by AI to keep it in line with the Islamic values espoused by the institution. This process requires care and digital literacy from teachers, so that the content used is not only attractive in form, but also valuable in substance. In addition to the technical and value aspects, the adoption of AI in early childhood education also encourages pedagogical transformation. Teachers are required to develop learning approaches that are more open to technology and responsive to the characteristics of today's digital generation. In this context, the role of AI as a learning tool is in line with Vygotsky's (1978) view on the importance of mediational tools in developing children's zone of proximal development (ZPD). With teacher guidance, AI can be a learning intermediary that allows children to develop English language skills in a more concrete, contextual, and meaningful way. Thus, it can be concluded that AI contributes to improving the quality of early English language teaching materials development through easy access to learning resources, media diversity, and teacher work efficiency. However, the utilization of this technology still requires infrastructure readiness, pedagogical competence, and sensitivity to the values and context of early childhood education.

4. CONCLUSION

This research shows that teachers at TKIT Model Madani Arrahman Pekanbaru have sufficient prior knowledge of Artificial Intelligence (AI) technology, although it is still limited to general use and has not been fully directed to the development of teaching materials. AI is considered to play a role in helping teachers create English teaching materials for early childhood that are more varied and interesting and enjoyable for early childhood. However, the application of AI still faces technical barriers, limited resources, and the need for content customization with early childhood characteristics. Thus, AI has great potential in supporting the development of early childhood English teaching materials, but it needs to be supported by training, infrastructure, and strengthening the capacity of teachers so that it can be implemented optimally and contextually.

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