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The Use of Game-Based Mechatronic Media to Stimulate Mother Tongue Development in Early Childhood

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ABSTRACT

Mother tongue mastery in early childhood plays a fundamental role in cognitive, social, emotional development and in the formation of cultural identity. However, globalization, modern parenting patterns, and the dominance of foreign-language digital media have weakened the use of the mother tongue in children's daily lives. This condition contributes to delays in language development, limited vocabulary, and difficulties in understanding instructions. At the same time, learning approaches in early childhood education remain largely traditional, minimally interactive, and insufficient in supporting active learning experiences. This study employs a qualitative approach through a literature review to examine the potential use of game-based mechatronic media in stimulating mother tongue development in early childhood. Mechatronic media, which integrate mechanics, electronics, and control systems, have been shown to create more interactive, responsive, and enjoyable learning environments. Such media function not only as educational tools but also as contextual play-based learning resources that encourage children to understand, imitate, and use their mother tongue naturally. The findings indicate that game-based mechatronic media can serve as an innovative solution to overcome the limitations of conventional methods while supporting the preservation of mother tongue languages. Nevertheless, the effectiveness of its implementation depends on high-quality design, active educator involvement, and support from the family environment. Therefore, the integration of technology, appropriate pedagogical approaches, and relevant language content is key to the successful stimulation of mother tongue development through this media.

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1. INTRODUCTION

Early childhood language development is an essential foundation that significantly determines children's future growth in cognitive, social, emotional, and academic domains. One of the main elements in children's language development is mastery and use of the mother tongue. The mother tongue is not merely the first means of communication introduced to children, but also a medium for internalizing values, culture, and local identity embedded within them (Setyowati *et al.*, 2022; Feridiyana, 2023). Through the mother tongue, children learn to express needs, convey emotions, understand instructions, and build connections with their social environment (Setiawan *et al*., 2024). In this sense, the mother tongue plays a crucial role in connecting children to their reality and the world around them.

Nevertheless, contemporary social, economic, and cultural dynamics indicate a concerning decline in the position of the mother tongue within society. Globalization and the rapid development of information technology have indirectly influenced communication patterns within families and educational institutions (Setyowati *et al.*, 2022). The use of foreign languages or code-switching in daily interactions is often perceived as a symbol of progress and intelligence, which gradually displaces the use of the mother tongue, even within the home environment. This situation weakens the role of the mother tongue in early socialization. A similar phenomenon is observed in early childhood education settings, where the mother tongue is no longer a primary priority in learning interactions (Feridiyana, 2023).

Recent studies indicate that many young children experience speech delays, difficulties in understanding instructions, or limitations in both active and passive vocabulary (Gustiana, 2024; Fitriani *et al.*, 2024). These conditions are often caused by a lack of meaningful language stimulation, both at home and in educational settings. Children are increasingly exposed to digital screens containing foreign-language content that is not always appropriate for their developmental stage (Hilmiah *et al.*, 2024; Krisna, 2024; Pradita *et al.*, 2024). Meanwhile, the role of teachers and parents as facilitators of language development has not been fully optimized due to limited understanding, time constraints, and a lack of systematic, engaging media for language stimulation (Feridiyana, 2023; Setiawan *et al.*, 2024; Wahidah and Latipah, 2021).

On the other hand, many early childhood education institutions still rely on traditional learning methods with minimal interaction and exploration. Storybooks, worksheets, and static visual media are still the main tools used in language learning (Hidayat *et al.*, 2023; Kolo *et al.*, 2022; Kotijah *et al.*, 2024). However, young children have unique learning characteristics. They learn best through play, movement, touch, and direct sensory experiences. Learning for young children is not passive but active, engaging their senses and emotions. As a result, learning approaches that integrate play, technology, and interactive language stimulation are urgently needed. These create meaningful learning experiences for children. Game-based mechatronic media emerge as a promising, innovative solution. Mechatronics, as an integration of mechanics, electronics, and control systems, offers significant potential for creating dynamic, responsive, and adaptive learning media (Kurnia *et al.*, 2024). When mechatronic elements are combined with educational games that embed mother tongue content, children are not only encouraged to play but also to understand, respond, and communicate actively using their mother tongue (Kurnia *et al.*, 2022b; Kurnia *et al.*, 2024). Such media can be designed to present sounds, movements, and

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visual elements that attract children's attention and stimulate curiosity, thereby fostering active engagement in the learning process.

The presence of mechatronic media in early childhood education should not be viewed merely as the use of technology, but rather as a response to the need for more contextual, personalized, and meaningful learning experiences. Compared to conventional media, mechatronic media offer greater flexibility and appeal, encouraging children to participate joyfully in language stimulation activities. Moreover, this type of media provides opportunities for experiential learning, in which children interact directly with tools, explore language use, and construct meaning through repeated actions and responses (Kurnia *et al.*, 2022a).

Considering the importance of mother tongue stimulation in supporting early childhood development and the need for learning media that bridge technology with play-based approaches aligned with children's characteristics, further investigation is necessary to examine how available learning media can be optimally utilized. Game-based mechatronic media represent one alternative that has been implemented in several early childhood education settings but has not yet been extensively explored in the context of mother tongue stimulation. Therefore, this study aims to examine and analyze "The Use of Game-Based Mechatronic Media in Stimulating Mother Tongue Development in Early Childhood" as an effort to understand the extent to which such media contribute to learning processes that support both language preservation and holistic language development in young children.

2. METHODS

This study employed a qualitative approach, using a literature review. This method was selected to examine various scholarly sources related to mechatronic media, educational games, and the stimulation of mother tongue development in early childhood.

Data were collected from scientific journals, books, research reports, and relevant documents that met the following criteria: published within the last five years (2021–2025), available in full-text format, and written in either Indonesian or English. The literature search utilized academic databases and digital repositories, including Google Scholar, ScienceDirect, and Garuda Ristekbrin, accessed with keywords related to the research topic. Analysis was conducted using content analysis techniques, including data reduction, thematic categorization, interpretation, and synthesis. The validity of the findings was strengthened through source triangulation and critical review of the selected literature.

3. RESULTS AND DISCUSSION

Mastery of the mother tongue from an early age is essential for children's holistic development and serves as the foundation for later language acquisition and learning. The mother tongue provides the first framework for communication and understanding, shapes self-concept, and strengthens cultural identity. Setyowati *et al.* (2022) emphasize that the mother tongue is "the primary vehicle for transmitting cultural values and local social norms embedded in children's identities." Through their mother tongue, children learn to comprehend instructions, express ideas and emotions, and build social relationships with people around them.

However, in the context of modern life, the position of the mother tongue has gradually become marginalized. Globalization, the influence of digital media, and the growing adoption of cosmopolitan values in parenting practices have contributed to shifts in

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language use both at home and in educational settings. According to Feridiyana (2023), the use of foreign languages within families is often perceived as a symbol of social status and intelligence, leading many parents to introduce foreign languages early, even before children have adequately mastered their mother tongue. This phenomenon is reinforced by the findings of Herd *et al.* (2015), who explain that the dominance of a second or foreign language may interfere with the acquisition and development of the first language, particularly when not accompanied by adequate guidance.

This situation has led to a decline in children's proficiency in their mother tongue, both receptively and productively. Studies by Gustiana (2024) and Fitriani *et al.* (2024) indicate an increasing number of young children experiencing speech delays, limited vocabulary, and difficulties in understanding verbal instructions. These conditions are exacerbated by the limited availability of meaningful language stimulation media in both family and early childhood education settings. Children tend to spend considerable time exposed to digital screens containing foreign-language content that is not always appropriate for their cognitive and linguistic developmental stages (Kanwal *et al.*, 2023; Hilmiah *et al.*, 2024; Krisna, 2024).

Meanwhile, learning approaches in many early childhood education institutions still rely heavily on traditional methods that offer limited interaction. Common instructional media include storybooks, word cards, and worksheets, which are generally one-directional and offer minimal opportunities for natural language exploration. Hidayat *et al.* (2023) note that conventional learning media have not sufficiently met children's needs for experiential and multisensory learning. In fact, young children possess active and concrete learning characteristics—they learn best through play, movement, touch, and spontaneous communication (Copple and Bredekamp, 2009; Dartini *et al.*, 2022).

At present, early childhood educators face increasingly complex challenges in designing effective learning strategies to stimulate children's language development. These challenges include adapting to technological advancements, understanding the diverse characteristics and needs of children, and implementing innovative, creative, and interactive teaching approaches (Triatna and Putro, 2024). Insufficient stimulation can negatively affect children's language development, which in turn may lead to cognitive and emotional difficulties (Putra *et al.*, 2018).

In this context, technological innovation in education plays a crucial role. One promising approach that has demonstrated positive impacts is the use of game-based mechatronic media. Mechatronics integrates mechanics, electronics, and control systems, enabling the development of learning media that are responsive, interactive, and adaptive to user behavior. Within early childhood education, such media can be designed as educational play tools that embed mother tongue elements into every activity.

Kurnia *et al.* (2024) report that mechatronic media are effective in attracting children's attention and increasing their engagement in learning activities. These media allow children to touch, move, listen, and respond to stimuli through commands delivered in the mother tongue, thereby enabling contextual, enjoyable two-way communication. As stated by Kurnia *et al.* (2022b), "mechatronic media function not only as learning aids but also as play companions that stimulate children to speak, imitate words, and understand meanings naturally."

This approach aligns with Kolb's (2014) experiential learning theory, which emphasizes that children learn most effectively through direct experience. In mechatronic-based media, each interaction is designed to generate meaningful experiences. For example, when a child presses a button with an animal image and hears the audio output, "This is a cat. A cat says

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meow," the child not only learns the word cat but also associates it with sound and action, making learning more contextual and meaningful.

International studies, such as those by Fleer *et al.* (2020), also support the importance of integrating technology into early childhood learning. Their findings indicate that interactive digital media can help children understand abstract concepts through concrete demonstrations and simple language. When such media employ the child's mother tongue, their effectiveness increases, as children feel more emotionally comfortable and linguistically familiar.

From the perspectives of teachers and parents, mechatronic media offer practical and flexible solutions. Wahidah and Latipah (2021) argue that early childhood educators who use mechatronic media are better able to create enjoyable and communicative learning environments. These media can accommodate children with diverse learning styles and varying language abilities. Moreover, mechatronic media can be adapted to local cultural contexts and everyday vocabulary, thereby serving not only as instructional tools but also as instruments for preserving the mother tongue within educational settings.

Nevertheless, several studies emphasize that the successful implementation of game-based mechatronic media depends heavily on the quality of media design, active teacher involvement, and support from the family environment. Media that are overly complex, lack contextual relevance, or merely showcase technological features without meaningful integration into the language may divert children's attention from learning objectives. Therefore, integrating technology, pedagogy, and linguistic content is essential to ensure effective implementation in early childhood education settings (Kurnia *et al.*, 2022a).

Overall, this literature review indicates that game-based mechatronic media represent a highly promising innovation for enhancing mother tongue stimulation in early childhood. This approach addresses the limitations of conventional teaching methods and responds to the challenges posed by globalization that increasingly marginalize the role of the mother tongue in children's lives. In addition to creating enjoyable learning environments, such media support contextual, experiential learning that aligns with young children's developmental characteristics.

4. CONCLUSION

The use of mechatronic media as a learning tool represents a promising innovation for stimulating the development of mother tongue in early childhood. This approach counteracts the marginalization of local languages by promoting language engagement, fostering vocabulary growth, and supporting children's cognitive and emotional development. Conventional learning media in early childhood education are often passive, less interactive, and do not match children's active, multisensory, and experience-based learning styles.

In contrast, mechatronic media offer dynamic, responsive, and contextual learning experiences. By integrating mechanics, electronics, and control systems, these media serve not only as instructional tools but also as playful learning companions that naturally encourage children to listen, imitate, and use their mother tongue. Furthermore, mechatronic media provide teachers and parents with the flexibility to adapt content to local culture and children's developmental needs.

However, the effectiveness of this approach depends greatly on the quality of media design, teachers' facilitation skills, and strong support from the family environment. To harness the full benefits of game-based mechatronic media and preserve local language and

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culture, educators, parents, and policymakers are urged to actively collaborate in adopting and refining these innovative tools for early childhood education.

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