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Mini Neuroscience Education: An Innovative Approach to Maternal Understanding of Child Development

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ABSTRACT

Background: *This study aimed to evaluate the effectiveness of Mini Neuroscience Education as an innovative approach to improving mothers' understanding of child growth and development in community-based maternal health programs.*

Methods: *A quasi-experimental study with a one-group pretest–posttest design was conducted in Kabupaten Banjar, South Kalimantan, Indonesia, involving 40 mothers with children aged 12–36 months selected through purposive sampling. The inclusion criteria comprised mothers who were willing to participate, had children within the specified age range, and completed all study procedures. Mothers who did not complete the intervention sessions or submitted incomplete questionnaires were excluded. Participants received Mini Neuroscience Education through videos, visual illustrations, and interactive explanations. The posttest was administered immediately after the intervention on the same day. Data were collected using a validated 15-item questionnaire and analyzed using the Wilcoxon signed-rank test.*

Results: *The mean score increased from 8.75 ± 2.10 at pretest to 12.88 ± 1.49 at posttest, with a mean difference of 4.13 ± 1.539. A statistically significant improvement was observed (Z = -5.481; $p < 0.001$), with 39 participants showing increased scores and one participant showing no change. The effect size (r = 0.88) indicated a very large intervention effect.*

Conclusion: *Mini Neuroscience Education demonstrated considerable potential as an innovative, practical, and community-friendly approach to enhancing maternal understanding of child growth and development.*

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INTRODUCTION

Optimal child growth and development is a crucial determinant of human resource quality, particularly during the first 1000 days of life, which is recognized as a critical period for brain development. During this period, children require appropriate stimulation and parental support to achieve optimal developmental outcomes. Mothers play a central role in providing stimulation, monitoring developmental milestones, and detecting early signs of developmental delays. However, many mothers still have limited understanding of child growth and development, particularly in aspects of stimulation and early detection, which may lead to delayed identification of developmental problems and negatively affect long-term child outcomes (Ayrancı Sucaklı & Yalçın, 2025; Estrada-Gutierrez et al., 2020; Sofia et al., 2026; Sofia & Zubaidah, 2025).

Insufficient maternal understanding of developmental milestones may have important consequences for children because mothers who are unable to recognize age-appropriate developmental achievements or warning signs may be less likely to identify developmental problems promptly and seek appropriate assessment or intervention. Delayed recognition can consequently postpone access to early intervention, despite evidence that early identification and timely intervention are important for supporting children's cognitive, social, and functional developmental trajectories. Previous studies have also demonstrated substantial gaps in parental knowledge of developmental milestones, highlighting the importance of strengthening parental capacity to actively monitor child development (Bear, 2004; Dong et al., 2023; Gayathri et al., 2023).

Various health education interventions have been implemented to improve maternal understanding, including conventional counseling, printed media, and digital applications. Although these approaches have shown positive effects, most rely on one-way information delivery and do not fully consider how the brain processes and retains information, limiting their effectiveness in promoting deeper understanding and long-term retention (Alinaitwe et al., 2024; Logsdon et al., 2015; Shalahuddin et al., 2025).

In contrast, neuroscience-based education integrates principles of cognitive processing, emphasizing visual engagement, emotional involvement, and multisensory learning, which have been shown to enhance comprehension and memory retention (Azzam & Easteal, 2021; Dorantes-Gonzalez et al., 2023; Shree, 2025). However, the application of neuroscience-based approaches in maternal and child health education remains limited, particularly in improving mothers' understanding of child development (Laurenzi et al., 2020; Walsh et al., 2024; Wilson & Landa, 2019). However, the application of neuroscience-based approaches in maternal and child health education remains limited, particularly in interventions designed to improve mothers' understanding of child development (Laurenzi et al., 2020; Walsh et al., 2024; Wilson & Landa, 2019).

Based on this gap, there is a need for an innovative educational approach that aligns with the natural mechanisms of brain function while remaining simple and applicable in community settings. This study introduces Mini Neuroscience Education as a concise, visual, and practical intervention specifically designed for mothers of young children. Unlike conventional health education methods, this approach incorporates several neuroscience-based principles, including neuroplasticity, multisensory learning, emotional engagement, attention enhancement, and memory consolidation. Educational materials were delivered through short-duration audiovisual content and practical demonstrations to stimulate multiple sensory pathways and strengthen information retention. The intervention was also designed to minimize cognitive overload while maximizing participant engagement and comprehension (Alam, 2026; Costa, 2023; Mantilla-Sánchez et al., 2026).

The novelty of this study lies not only in the integration of neuroscience principles into maternal health education but also in the development of a brief, community-friendly, and easily applicable educational model for improving mothers' understanding of child growth and development. More importantly, this study contributes new knowledge by extending the application of neuroscience-informed learning principles beyond conventional educational settings into maternal and child health education. The findings provide empirical evidence regarding whether a brief, neuroscience-based educational intervention can improve maternal understanding of child development and may inform the development of future community-based educational strategies that are more cognitively engaging and potentially more effective than conventional information-delivery approaches. Therefore, this study aimed to examine the impact of Mini Neuroscience Education on maternal understanding of child growth and development. Therefore, this study aimed to examine the impact of Mini Neuroscience Education on maternal understanding of child growth and development.

MATERIALS AND METHOD

Research Design

This study employed a quasi-experimental design using a one-group pretest–posttest approach to evaluate the effectiveness of Mini Neuroscience Education in improving mothers' understanding of child growth and development. A control group was not included because this study was designed as an initial evaluation of the intervention in a community-based setting, with the primary objective of assessing changes in participants' understanding before and after receiving Mini Neuroscience Education. In addition, the study was conducted within a limited target population in one village, making the allocation of participants into intervention and control groups less feasible. Providing the educational intervention to all eligible participants was also considered more appropriate from a practical and ethical perspective, as the intervention was designed to provide potentially beneficial information regarding child growth and development. Therefore, a one-group pretest–posttest design was considered appropriate for obtaining preliminary evidence regarding the potential effectiveness of the intervention.

Study Setting and Participants

This study was conducted in one village within the working area of Astambul Primary Healthcare Center, Kabupaten Banjar, South Kalimantan, Indonesia. The target population comprised mothers with children aged 12–36 months living in the study area. Participants were recruited using a purposive sampling technique based on predetermined eligibility criteria. The sample size was determined based on the availability of eligible mothers within the selected study area during the recruitment period. A total of 40 mothers who met the eligibility criteria and agreed to participate were included in the study.

Inclusion criteria included mothers who had children aged 12–36 months, agreed to participate in the study, attended the educational session, and completed all study procedures. Exclusion criteria included mothers who were unable to complete the intervention, failed to complete the questionnaires, or withdrew from the study before its completion.

Instrument and Measurement

Data were collected using a structured questionnaire consisting of 15 items measuring mothers' understanding of child growth and development. The instrument was developed and tested prior to data collection. Validity testing was conducted using item-total correlation, and items that did not meet the validity criteria were revised or excluded. Reliability testing showed that the instrument had acceptable internal consistency, with a Cronbach's alpha coefficient of 0.692. Although this value was slightly below the commonly applied threshold of 0.70, it was considered acceptable for an exploratory study involving a newly developed instrument and a relatively small number of items.

Research Procedure

The study was conducted in three stages. First, participants completed a pretest questionnaire to assess their baseline understanding of child growth and development. Second, participants received the Mini Neuroscience Education intervention, which was delivered directly by the principal researcher together with the research team using a standardized educational procedure. All participants received the same educational content and materials.

The intervention combined audiovisual learning with printed educational materials. An educational video of approximately 7 minutes was presented while participants received an educational module entitled *The Importance of Child Growth and Development in Children Aged 1–3 Years*. The 29-page module contained information on the concepts of child growth and development, developmental milestones, factors influencing child development, age-specific stimulation methods, warning signs of developmental delay, and recommendations for parents.

Following the video presentation, the principal researcher provided an explanation based on the content presented in the video and module for approximately 10 minutes. The explanation was delivered using visual illustrations, interactive explanations, and practical examples to reinforce participants' understanding.

The intervention incorporated several neuroscience-informed learning principles, including multisensory learning, visual attention, emotional engagement, and memory consolidation. The combination of audiovisual content, printed materials, verbal explanation, visual illustrations, and practical examples was intended to engage multiple sensory pathways and facilitate comprehension and retention of information.

The intervention session lasted approximately 17 minutes, consisting of a 7-minute video presentation and approximately 10 minutes of explanation and reinforcement. The same intervention materials and delivery sequence were used for all participants to maintain consistency.

Third, participants completed the posttest questionnaire immediately after the intervention on the same day to assess changes in their understanding of child growth and development while minimizing potential influences from external sources.

Data Analysis

Data were analyzed using IBM SPSS software version 22. Descriptive statistics were used to summarize respondent characteristics and understanding scores. Normality testing was conducted using the Shapiro–Wilk test, which indicated that the data were not normally distributed ($p < 0.05$). Therefore, inferential analysis was performed using the Wilcoxon signed-rank test to compare pretest and posttest scores. The effect size was calculated using the formula $r = Z/\sqrt{N}$ to determine the magnitude of the intervention effect.

Ethical Consideration

This study adhered to ethical principles, including informed consent, confidentiality, and voluntary participation. Ethical approval was obtained from the Health Research Ethics Committee of Poltekkes Kemenkes Banjarmasin (No. 007/KEPK-PKB/2026).

RESULTS

A total of 40 mothers participated in this study. The characteristics of respondents are presented in Table 1. The mean age of respondents was 30.67 ± 7.39 years. Most respondents had a junior high school education (40.0%) and were housewives (90.0%).

Table 1. Characteristics of Respondents (n = 40)

Characteristics	n	%
Age (years)		
Mean ± SD	30.67 ± 7.39	
Education		
Elementary/No school	9	22.5
Junior high school	16	40.0
Senior high school	12	30.0
Diploma/Bachelor	3	7.5
Occupation		
Housewife	36	90.0
Private sector	4	10.0
Number of children		
1	16	40.0
2	14	35.0
≥3	10	25.0

The comparison of pretest and posttest understanding scores is presented in Table 2. The mean pretest score was 8.75 ± 2.10, which increased to 12.88 ± 1.49 at posttest, with a mean difference of 4.13 ± 1.539, indicating a substantial improvement in mothers' understanding following the intervention.

Table 2. Comparison of Pretest and Posttest Understanding Scores

Variable	Pre-test		Post-test	
	Mean	SD	Mean	SD
Understanding score	8.75	2.10	12.88	1.49

The results of the Wilcoxon signed-rank test indicated a statistically significant difference between pretest and posttest scores ($Z = -5.481$; $p < 0.001$). A total of 39 respondents showed an increase in understanding, while one respondent showed no change and none showed a decrease, indicating a consistent positive effect of the intervention across participants.

In addition to statistical significance, the magnitude of the intervention effect was assessed using effect size analysis. The calculated effect size ($r = 0.88$) indicated a very large effect, demonstrating substantial practical significance. These findings confirm that Mini Neuroscience Education was highly effective in improving mothers' understanding of child growth and development.

DISCUSSION

The findings of this study demonstrated that Mini Neuroscience Education had a consistent positive effect on improving mothers' understanding of child growth and development, as indicated by the increase in scores among almost all participants. The very large effect size (r = 0.88) further confirms that the intervention was not only statistically significant but also had substantial practical significance. This suggests that the approach used in this study was highly effective in enhancing understanding outcomes (Azzam & Easteal, 2021; Pradeep et al., 2024; Winitsiri & Srikoon, 2026; Zhumabayeva et al., 2025).

The findings may also be interpreted from the perspective of neuroplasticity, which suggests that repeated sensory stimulation strengthens neural pathways associated with learning and memory. In the present study, participants received information through multiple sensory channels, including visual illustrations, spoken explanations, demonstrations, and practical examples. This combination is consistent with dual coding theory, which proposes that information presented simultaneously through verbal and visual pathways is processed more efficiently and retained for a longer period. Consequently, participants were more likely to understand and recall the information presented during the intervention (Beghdadi & Khellafi, 2025; Chai et al., 2021; Gkintoni et al., 2025; Green, 2024).

The present findings are consistent with previous studies demonstrating that interactive and visually enriched educational strategies significantly improve participants' understanding and engagement. Reported that neuroscience-based educational interventions improved teachers' knowledge and confidence by promoting active engagement and emotional involvement (Brick et al., 2021). Similarly, (Galmarini et al., 2024) and (Wang et al., 2025) emphasized that integrating multiple sensory modalities enhances information processing and long-term retention. However, most previous studies were conducted in educational institutions or clinical settings, whereas the present study implemented the intervention in a community-based context involving mothers with diverse educational backgrounds. This difference highlights the adaptability and potential scalability of the intervention in primary healthcare settings.

Conversely, several studies have reported less substantial improvements when educational interventions relied predominantly on one-way communication strategies. (Cheng et al., 2025) demonstrated that visual materials alone were insufficient to optimize learning outcomes when opportunities for interaction and reinforcement were limited. Similarly, (Dönmez & Çatar, 2026) emphasized that participant characteristics, educational background, and intervention duration strongly influence the effectiveness of educational programs. These findings may explain why the effect size observed in the present study was considerably larger. In addition to audiovisual materials, the intervention included interactive communication, emotional engagement, repetition of key concepts, and practical examples closely related to participants' daily experiences. Such characteristics may have enhanced attention, strengthened memory consolidation, and improved learning outcomes.

From a practical perspective, the findings of this study have important implications for maternal and child healthcare services. Community-based health programs, including *posyandu* activities and primary healthcare services, frequently face challenges related to limited resources, insufficient educational materials, and varying levels of health literacy among caregivers. Mini Neuroscience Education addresses these challenges by providing a concise, visually engaging, and easily applicable educational model that can be delivered within a relatively short period while maintaining a high level of participant engagement.

However, this study has several limitations. The use of a one-group pretest–posttest design without a control group limits the ability to establish causal inference. In addition, the short duration of the intervention does not allow for evaluation of long-term retention or behavioral changes. Future research is recommended to include control groups, larger sample sizes, and follow-up assessments to evaluate the sustainability of the intervention effects.

Overall, the findings support the hypothesis that Mini Neuroscience Education is effective in improving mothers' understanding of child growth and development and provides a promising, evidence-based approach for enhancing maternal education in community health settings.

CONCLUSION

Mini Neuroscience Education demonstrated significant effectiveness in improving mothers' understanding of child growth and development. The findings indicate that the intervention not only achieved statistical significance but also demonstrated a very large practical impact, highlighting its effectiveness as an educational approach. This study confirms that integrating neuroscience principles into health education can enhance learning outcomes among mothers and supports its application in community-based health settings. The results suggest that Mini Neuroscience Education has strong potential to be implemented in primary healthcare services, such as posyandu and community health centers. Future research is recommended to include a control group and longer follow-up periods to evaluate the sustainability of outcomes and to explore its impact on behavioral changes in child care practices.

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