Innovation in Designing Interactive Game-Based Tactile Carpets for Sensory and Motor Stimulation in Early Childhood

Elvira Khori Ulni[1][a], Effran Zudeta[2][b] and Amalia Husna[1][c]
[1]*Universitas Negeri Padang, Indonesia*
[2]*Universitas Mercubaktijaya, Indonesia*

Keywords: Early Childhood Development, Sensorimotor Stage, Tactile Carpet, Multisensory Learning, Sensory Stimulation, Texture Exploration.

Abstract: Early childhood is at a crucial stage of sensorimotor development, where learning occurs through direct experiences such as touching, feeling, seeing, and moving. Therefore, learning media that can stimulate multiple senses simultaneously is necessary to make information easier to understand and enjoy. One appropriate medium for this need is a tactile carpet, an interactive carpet with a variety of textures and surfaces specifically designed for children to explore. Tactile carpets not only provide sensory stimulation but can also be linked to the introduction of various animals. Each area of the carpet has a different texture, and in each area, relevant animals are introduced. Through this exploration, children not only learn to recognize various types of textures but also connect sensory information with real-life concepts about animals and their environment. Tactile carpets are linked to a game of finding animals among the many toys scattered on the carpet's surface. This activity simultaneously develops motor skills, tactile sensitivity, imagination, and naturally enriches children's vocabulary. Using the 5W + 1H approach, this tactile carpet was developed as a fun and educational play-learning medium. The design process involved observations, interviews, and hands-on testing with children to ensure the rug was safe, engaging, and developmentally appropriate. The tactile, animal-themed rug is expected to be an effective learning tool for children, helping them understand the world around them through fun, meaningful, and active exploration.

1 INTRODUCTION

Enjoyable learning creates a comfortable and harmonious learning atmosphere, especially in early childhood education. At this stage, learning takes place through a playful learning approach, in accordance with the characteristics of a child's world which is full of exploration and play (Helleman et al., 2023). Play stimulates various areas of development, including cognitive, motor, and language skills, as well as fostering creativity and problem-solving abilities (da Silva et al., 2024; Fan et al., 2024). Play encourages social interaction, improves communication skills and relationships with peers, which are crucial for academic success and emotional well-being (Lubis, 2019). In addition, play is also important for children's physical and mental health (Dodd et al., 2021). Play is not only a fun activity, but also the primary means for children to learn about the world around them and develop various aspects of development.

Early childhood is at a crucial stage of sensorimotor development, where learning occurs through direct experiences such as touching, feeling, seeing, and moving. Therefore, multisensory stimulation is essential to make the learning process more meaningful and enjoyable. Involving multiple senses in the learning process has been shown to improve children's memory and concentration. A study found that preschoolers who received multisensory learning experiences showed up to a 35% increase in their cognitive abilities, particularly in memory and attention (Dahua et al., 2024). Children who learn through a multisensory approach

[a] https://orcid.org/0009-0002-7359-5634
[b] https://orcid.org/0000-0001-8416-6873
[c] https://orcid.org/0009-0006-7033-4892

Ulni, E. K., Zudeta, E. and Husna, A.
Innovation in Designing Interactive Game-Based Tactile Carpets for Sensory and Motor Stimulation in Early Childhood.
DOI: 10.5220/0014069300004935

In *Proceedings of the 7th International Conference on Early Childhood Education (ICECE 2025) - Meaningful, Mindful, and Joyful Learning in Early Childhood Education*, pages 169-176
ISBN: 978-989-758-788-7; ISSN: 3051-7702

use all their senses, which helps strengthen neural development. This approach is beneficial for children with communication and language difficulties, as it involves various sensory modalities that can strengthen neural connections and improve learning outcomes (Tubele, 2023). Providing appropriate stimulation will support optimal cognitive, motor, social-emotional, and language development in children. One way to provide this stimulation is through learning media designed according to the child's developmental stage.

Learning media in the context of early childhood must be able to involve various senses simultaneously. Concrete and interactive media have been proven to be more effective in building children's understanding. Tactile media in early childhood education includes various activities that stimulate the sense of touch, such as touch through massage, exploration of various textures, to experiences related to body awareness (proprioception) (Roziah, 2019). These activities have an important role in supporting children's psychomotor development and contribute to improving cognitive abilities and social emotional aspects and can improve children's neuromotor, cognitive, and socio-affective development (Camacaro, 2013). The importance of integrating tactile experiences into educational activities, as a means to build warmer communication and emotional connections between educators and children. This approach is considered capable of encouraging comprehensive or holistic development in the early childhood learning environment.

One innovative learning medium that supports multisensory stimulation is tactile carpet, an interactive carpet with a variety of textures and surfaces specifically designed for children to explore. Play environments designed with smooth textures, both soft and hard, better support the duration of early childhood play activities, and varied play surfaces create a more engaging play environment and support children's exploration (Zahra et al., 2019). In reality, not all children have the opportunity to interact directly with various natural textures such as grass and rocks. Many parents in urban areas are very busy working, so they rarely have time to play with their children. Furthermore, the limited availability of green open spaces in urban areas (PUPR, 2020) is a challenge in itself, so children miss the opportunity to experience the diversity of environmental textures directly. In this context, tactile carpet can be a practical and educational alternative solution. By presenting textures that resemble real environments, tactile carpets allow children to explore the sensation of touching various surfaces without having to go to a specific location. This approach aligns with the concept of a simulated natural environment (Chawla, 2015), where natural elements are replicated in the learning space to provide a multisensory experience that benefits children's cognitive, motor, and language development.

Interaction with various textures such as rough, smooth, or springy on tactile carpets helps enrich children's sensory experiences (Moreno, 2015). This type of multisensory stimulation plays an important role in strengthening sensorimotor nerve connections in the brain, which support movement coordination, perception, and responses to environmental stimuli (Case-Smith & O'Brien, 2015). Tactile carpets not only stimulate the sense of touch but can also be a means of introducing real-world concepts, such as animals. This learning activity can be enriched with a game of finding animals among the many toys scattered on the carpet's surface. This game combines aspects of tactile exploration with visual search, thus encouraging children to connect sensory information (texture) with cognitive information (types of animals). According to Zahra et al (2019), a learning process that combines direct experience, exploration, and reflection will strengthen conceptual understanding as well as fine motor skills. In addition, the activity of finding animals also trains focus, concentration, and problem-solving skills, because children must distinguish relevant toys (animals) from inappropriate objects. According to Tūbele (2023), play activities that involve sorting and classifying objects according to certain categories can develop logical thinking skills in early childhood.

Through the 5W + 1H approach (What, Who, When, Where, Why, How), tactile carpets are developed as educational and fun play-learning media, which not only meet the needs of early childhood sensory development but also support contextual thematic learning. Toys that combine visual, auditory, and tactile stimuli increase the interest and engagement of children aged 3–6 years. Integrated tactile stimulation also helps children build descriptive vocabulary and understanding of objects based on tactile sensations (Fan et al., 2024). However, currently there are still many early childhood children who do not have access to learning media that are appropriate to their needs and developmental stages. Therefore, this research is important to develop innovative learning media based on tactile carpets as an alternative solution that can be integrated into the learning process in early childhood environments.

2 METHOD

This research is a type of research and development (R&D). R&D is a research method used to produce a product and test its effectiveness. This development research refers to the ADDIE (analysis, design, development, implementation, & evaluation) development model. The research was conducted in 10 early childhood schools in Padang, West Sumatra. The subjects tested for the tactile carpet media product were feasibility test subjects. The product feasibility was assessed by the experts involved: a) Media experts who mastered media concepts; b) Material experts who mastered early childhood materials; and c) Early childhood teachers, consisting of 5 teachers in the initial field trial and 18 teachers in the main field trial.

$$\bar{x} = \Sigma x / N$$

Description
$\bar{x}$: Average score
Σx :Total scores
N : Number of people assessing

The instrument used was a questionnaire. The questionnaire was used by material experts, media experts, and early childhood teachers. The questionnaire functioned to assess product quality and obtain suggestions for product development. The study used two analytical techniques: qualitative descriptive analysis and quantitative descriptive analysis. Qualitative descriptive analysis presented data in the form of assessments or reviews provided by media experts, material experts, and teachers. The results of the data analysis will serve as a basis for product improvements. Quantitative descriptive analysis is used to describe the data resulting from the percentage analysis that has been made. Data processing is obtained through a questionnaire in the form of descriptive percentages from each subject to determine product feasibility as follows:

Table 1: Product Eligibility Categories.

Score Interval	Criteria
$x \geq 4.2$	Very Good
$3.4 \leq x < 4.2$	Good
$2.3 \leq x < 3.4$	Fairly Good
$1.8 \leq x < 2.3$	Not Good
$x < 1.8$	Bad

3 RESEARCH RESULTS

The listening text material which will be in the form of 5W + 1H questions (What, Who, When, Where, Why, How) which will be asked to early childhood children when playing with tactile carpets is given to material experts to then be assessed by filling out a questionnaire on a scale of 4. The results of the material expert's assessment can be seen in Table 2 below.

Table 2: Summary of Average Scores from Material Expert Validation Results.

No	Assessment Aspect	Average Score	Category
1	Suitability to Child's Ability	3.86	Good
2	Language Skills	3.66	Good
3	Presentation Suitability	4.40	Very Good
Total		11.92	
Average		3.97	Good

The assessment shows an average in the good category. The input from the material expert is: 1) Question material that is close or familiar to children 2) Question text should not be too long for early childhood 3) Question cards should be provided categorized or divided into groups (What, Who, When, Where, Why, How)

Input from material experts during the validation phase suggested two key points for improving the tactile carpet media. First, use places and names in the text that are close or familiar to children. This principle is in line with contextual learning theory, which emphasizes the importance of linking material to the environment and real-life experiences of students (Pacini-Ketchabaw et al., 2016). Early childhood children tend to more easily understand information that is linked to things they are familiar with, such as the names of places around their home or school, so that learning becomes more meaningful (Chung, 2022). Second, question texts should not be too long for early childhood. Children in the preoperational stage have limited working memory capacity, so instructions or questions that are too long can reduce focus and understanding. Muthanje (Muthanje, 2023) also showed that short, clear sentences and using simple vocabulary are more effective in increasing children's participation in learning. By implementing these two inputs, tactile carpet media can be more child-friendly, facilitate understanding, and increase student engagement in learning activities. Adapting content to the child's cognitive development level and life context also has

the potential to strengthen learning motivation and transfer knowledge to real-life situations.

Providing question cards categorized or divided into What, Who, When, Where, Why, and How groups can be an effective strategy for developing critical thinking skills and language skills in early childhood. This approach refers to the concept of questioning techniques in learning, where questions are directed to encourage exploration, understanding, and reinforcement of concepts (Pant et al., 2024). What and Who-type questions help children recognize objects, events, or figures, as well as expand basic vocabulary. When and Where questions train children's understanding of the concepts of time and space, which are important parts of cognitive development in the preoperational stage (Musnir & Sumantri, 2019). Meanwhile, Why and How questions stimulate higher-order thinking skills, training children to make cause-and-effect relationships and explain the process of an event (Moreno, 2015). This grouping of questions also makes it easier for teachers to design systematic and gradual tactile carpet-based learning. With a structured format, teachers can adjust the difficulty level of questions to suit the child's abilities, while ensuring that all aspects of language skills, from literal comprehension to logical reasoning, are trained in a balanced manner (Servelin et al., 2019).

The tactile carpet media to be used was given to media experts to then be assessed by filling out a questionnaire on a scale of 4. The results of the media expert's assessment can be seen in Table 3 below.

The assessment shows an average in the very good category. The input from media experts is: 1) For the texture of the tactile carpet must be made with good quality, such as grass and stones, must be made as similar as possible. 2) The carpet must be able to be disassembled like puzzle pieces to save space 3) in each texture there is not only one carpet but the number is increased for example a grass themed carpet 3 carpets and a stone themed carpet 3 carpets, The quality of the design of learning media, especially tactile carpets, is a key factor that determines its effectiveness in supporting multisensory stimulation of early childhood. Tactile carpets designed with textures that resemble real conditions such as grass and stones can increase the realism of children's learning experiences. Early childhood is in the preoperational stage of development, where learning is more effective through concrete direct experience (Rahman & Nuraini, 2023). By presenting textures that are visually and tactilely accurate, children can more easily build new cognitive schemes through exploration of the sense of touch. In addition to the realism of texture, the functional aspect also plays an important role. Tactile carpets that can be disassembled like puzzle pieces provide flexibility of use in various spaces, save storage space, and make it easier to arrange according to the learning theme. This advantage is in line with the view (Rupnidah & Suryana, 2022) that effective learning media must consider ease of use, portability, and suitability to user needs.

Table 3: Summary of Average Scores from Media Expert Validation Results.

No	Assessment Aspect	Average Score	Category
1	Content Quality	4.33	Very Good
2	Learning goal alignment	4.14	Good
3	Feedback and adaption	5.00	Very Good
4	Affective	4.83	Very Good
5	Presentation design	4.85	Very Good
6	Interaction	4.00	Good
7	Accessibility	5.00	Very Good
8	Usability	4.50	Very Good
9	Standards compliance	4.50	Very Good
Total		41.15	
Average		4.57	Very Good

The addition of units for each texture theme, for example three grass-themed carpets and three stone-themed carpets, serves to support group learning activities. This minimizes queues for use, increases children's exploration opportunities, and supports social interaction through cooperative play. Aryanti (2024) emphasized the importance of social interaction in learning, where cooperative activities can expand children's Zone of Proximal Development (ZPD). The results of the media expert assessment showed that the tactile carpet design met the "very good" category in terms of visual, functional, and suitability for learning objectives. This finding strengthens the opinion of Rohibni et al (2022) that effective learning media must meet three main criteria: aesthetically appealing, relevant to learning objectives, and easy to use by target users. However, constructive input from media experts is still needed to improve product quality, including improving texture, material durability, and design variations. By combining visual quality, texture realism, design flexibility, and support from media expert studies, tactile carpets can be an innovative learning media that is not only attractive but also optimally supports

the cognitive, sensorimotor, and social-emotional development of early childhood.

Table 4: Summary of Average Scores from Initial Field Trial Results.

No	Assessment Aspects	Assessment Score					Total score	Average	Category
		1	2	3	4	5			
1	Attractive		10	15	72	10	107	3.56	Good
2	Easy to use				148	15	163	4.07	Good
3	Content Quality				152	10	162	4.05	Good
Total							437	11.68	
Average								3.97	Good

Media assessment during the initial field trial phase showed overall good product results, supplemented by suggestions for improvement. The results of the initial field trial phase are shown in Table 4 below.

Initial field trials, teachers as respondents provided comments and suggestions The comments from teachers were 1) The use of tactile carpet media is very interesting and makes it easier to convey the material. 2) The material is explained in a coherent manner that is easy to understand for early childhood In addition to positive comments, teachers provided comments and suggestions for the products developed as follows: 1) There should be a guidebook for implementing learning using tactile carpets 2) The design of the question cards is made with a colorful design and added with interesting characters.

The results of the initial field trial showed that teachers responded positively to the use of tactile carpet media. Teachers considered this media very interesting and made it easier to convey material to early childhood. This is in line with the opinion of Kmurawak & Setyaningsih (2020) that interesting learning media can increase student attention, motivate learning, and facilitate understanding of the concepts being taught.

The teacher also mentioned that the material presented through the tactile carpet media was delivered in a coherent manner so that it was easy for early childhood children to understand. According to Sumarmi & Afendi (2022), early childhood children are in the pre-operational stage, where the learning process will be more effective if the material is delivered in a structured manner, using concrete media, and supporting direct experience. Tactile carpet media designed with a coherent learning flow helps children understand the material through multisensory experiences. In addition to positive comments, the teacher provided several suggestions for product development. First, the need for a tactile carpet usage guidebook. This guidebook will serve as a guide for teachers in implementing the media, starting from preparation, implementation steps, to learning evaluation. According to Rosalianisa et al. (2023), media usage guidelines play an important role in ensuring consistency of application and maximizing the benefits of the media in various learning contexts.

Second, the teacher suggested that the question card design be made more colorful and equipped with interesting characters. Visual designs rich in color and illustrations can increase learning motivation in early childhood. Sudarsana et al. (2020) showed that children are more interested in media that displays bright visual elements and familiar characters, because it can foster curiosity and trigger interaction. The addition of characters to the question cards can also function as a visual stimulus that strengthens the association of learned concepts (Mardhatillah, 2021). Overall, input from teachers at this initial stage is an important foundation for refining the tactile carpet media before wider scale trials. Improvements in aspects of the user guide and visual design are expected to increase the effectiveness of the media in supporting the learning process in early childhood.

The main field trial received an overall rating of "very good," with suggestions for improvement. The results of the main field trial assessment can be seen in Table 5 below.

Main field trial, teachers as respondents provide comments and suggestions. The comments from teachers are: 1) Tactile carpet media is now more flexible to use 2) the appearance of the carpet is attractive 3) easy to use. In addition to comments, teachers provide suggestions for the products being developed as follows: 1) tactile carpet media should be produced in larger quantities so that it can be used in many schools 2) various characters and animals can be added

The results of the main field trial showed that teachers as respondents gave positive comments on the tactile carpet media developed. These comments covered three aspects: flexibility of use, attractive appearance, and ease of use. These three aspects reflect that the developed media has met most of the criteria for effective learning media (Rahman & Nuraini, 2023), namely practicality, attractiveness, and ease of use by both educators and students. The flexibility of using tactile carpet media is an important point, because it allows teachers to adjust its use in various learning contexts, both in the

classroom and outside the classroom. This is in line with Mardhatillah's opinion (2021) that flexible learning media can increase student engagement and make it easier for teachers to adapt materials according to needs. In addition, the visually appealing appearance of the carpet can increase learning motivation in early childhood. Media with an attractive design can stimulate interest in learning and increase children's attention to the material being presented.

Table 5: Summary of Average Scores from the Main Field Trial Results.

No	Assessment Aspects	Assessment Score					Total score	Average	Category
		1	2	3	4	5			
1	Attractive			6	316	135	457	4.23	Very Good
2	Easy to use			3	396	220	619	4.29	Very Good
3	Content Quality				396	225	621	4.31	Very Good
Total							1697	12.83	
Average								4.28	Very Good

The ease of use of the media is also an advantage, considering that teachers need tools that do not require complicated operational procedures. This ease makes the media more quickly adopted and used sustainably (Kmurawak & Setyaningsih, 2020). This is especially important in early childhood education, where the focus of learning is on exploration, interaction, and direct experience. In addition to positive comments, teachers also provided constructive suggestions for further development. First, the tactile carpet media should be produced more widely so that it can be used in various schools. This suggestion shows the potential for wider product implementation (scalability), which is in line with the principle of diffusion of innovation in education (Rohibni et al., 2022), where the dissemination of media that has been proven effective needs to be pursued so that its benefits can be felt by more students.

Second, adding a variety of characters and animals to the tactile carpet media is considered to increase attractiveness and expand learning content. According to multisensory learning theory (Case-Smith & O'Brien, 2015), variations in shapes, colors and objects introduced through tactile media can enrich children's learning experiences, help develop vocabulary, and strengthen associations between visual, tactile and language experiences. Thus, the findings of this trial not only confirm the success of the initial design of tactile carpet media, but also provide useful input for further product development, both in terms of distribution and content variations. Strengthening the aesthetic aspects and media content will further increase the potential of tactile carpet media to become an adaptive, interesting and effective learning tool for young children.

The final form of the product developed is a tactile carpet for early childhood. The tactile carpet was developed from 4 main components, namely 1) A carpet consisting of 4 textures, namely stone, grass, foam, fur in the form of a puzzle and can be disassembled 2) Animal miniature toys, 3) a guidebook for using the tactile carpet 4) 5W + 1H statement cards (What, Who, When, Where, Why, How)

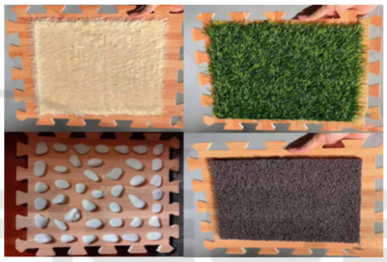

Figure 1: The carpet consists of 4 textures, namely fur, stone, grass and soft foam.

Figure 2: Carpets can be put together like a puzzle.

Figure 3: Miniature Animals and other Toys to use in the game of finding animals on the carpet.

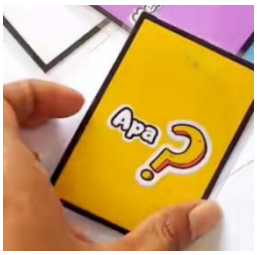

Figure 4: Question Card.

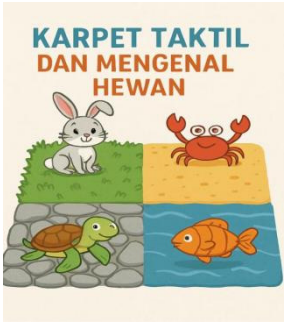

Figure 5: Guide Book.

The general description of the implementation of the tactile carpet in the guidebook is as follows: (1) Many toys are spread on the surface of the carpet and children are asked to look for the animal requested by the teacher (2) After finding the toy, children are asked to take a question card and children are asked to answer the question, the question in question is according to the animal taken (3) If the child is successful in answering the child can play with the toy, if not the child must return the toy to the carpet.

4 CONCLUSION

The use of tactile carpets in early childhood learning is used to enrich sensory experiences through direct interaction with various textures, such as smooth, rough, hard, soft and fluffy. This media not only stimulates the sense of touch, but also helps children connect tactile experiences with real concepts while playing with animals. The design of the tactile carpet that can be disassembled like puzzle pieces, with good visual and functional quality, facilitates storage, maximizes the variety of activities, and extends the media's lifespan. Support from media experts indicates that this carpet has met the criteria for learning eligibility, although constructive feedback is still needed for quality improvement. The tactile carpet also uses a guidebook to facilitate use. With proper application, tactile carpets have the potential to be an effective, fun, and multifunctional educational tool to develop fine motor skills, enrich vocabulary, build imagination, and strengthen children's sensorimotor nerve connections.

REFERENCES

Aryanti, P. G., Lailany, A. A., Amelia, I., *Regita*, A. N. H., Setiawan, K. M. P., & Yel, M. B. (2024). Media Interaktif Pembelajaran Berbasis Multimedia menggunakan Adobe Flash untuk TK dan PAUD. *AJAD Jurnal Pengabdian Kepada Masyarakat*, *4*(1). https://doi.org/10.59431/ajad.v4i1.282

Camacaro, M. (2013). *Educational Strategies for sense approach physical education in touch child*. *37*(78), 96–108. http://www.scielo.org.ve/pdf/ri/v37n78/art05.pdf

Case-Smith, J., & O'Brien, J. C. (2015). *Occupational Therapy for Children and Adolescents*. St. Louis: Mosby.

Chawla, L. (2015). Benefits of nature contact for children. *Journal of Planning Literature*, 30(4), 433–452. https://doi.org/10.1177/0885412215595441

Chung, K. D. (2022). Drawing as an encounter with materials in early childhood education spaces. *International Journal of Education Through Art*, *18*(2), 181–189. https://doi.org/10.1386/eta_00093_3

da Silva, E., Amaral Ramos, C., da Silva Mendes, M. A., Trevizan Tramontina, F., & da Silva, J. M. (2024). Playing in early childhood education. *Revista Gênero e Interdisciplinaridade*, *5*(05), 86–96. https://doi.org/10.51249/gei.v5i05.2226

Dahua Robelly, J. E., Chocano Mena, M., Hurtado Abad, J. del R., & Silva, L. J. (2024). Evaluación del impacto de la integración multisensorial en el desarrollo neurosensorial de niños preescolares: un estudio en el Centro de Desarrollo Neurosensorial y Rehabilitación Integral Úpala Kids. *Polo Del Conocimiento*, *9*(12), 1029–1046. https://doi.org/10.23857/pc.v9i12.8527

Dodd, H. F., Nesbit, R. J., & Maratchi, L. R. (2021). Development and evaluation of a new measure of children's play: the Children's Play Scale (CPS). *BMC Public Health*, *21*(1), 878. https://doi.org/10.1186/S12889-021-10812-X

Fan, Y., Chong, D. K., & Li, Y. (2024, March). Beyond play: a comparative study of multi-sensory and traditional toys in child education. In *Frontiers in Education* (Vol. 9, p. 1182660). Frontiers Media SA. https://doi.org/10.3389/feduc.2024.1182660

Helleman, G., Nio, I., & De Vries, S. I. (2023). *Playing outdoors: What do children do, where and with whom?* https://doi.org/10.37291/2717638x.202343285

Kementerian Pekerjaan Umum dan Perumahan Rakyat. (2020). *Pedoman Penyediaan dan Pemanfaatan Ruang Terbuka Hijau*. Jakarta: Direktorat Jenderal Cipta Karya.

Kmurawak, R., & Setyaningsih, D. (2020). *Use Of Augmented Reality as A Learning Media In Early Childhood Education Solideo Perumnas I Jayapura*. *3*(1), 1–5. https://doi.org/10.23917/ECRJ.V3I1.10544

Lubis, M. Y. (2019). Mengembangkan sosial emosional anak usia dini melalui bermain.*Geotechnique*, *2*(1), 47–58. https://doi.org/10.25299/GE.2019.VOL2(1).3301

Mardhatillah, M. (2021). Media learning for early childhood in early childhood education. *Sensei International Journal of Education and Linguistics*. https://doi.org/10.53768/sijel.v1i4.109

Moreno Lucas, F. M. (2015). *Función pedagógica de los recursos materiales en educación infantil / Pedagogical function of material resources in early childhood education*. *133*, 12–25. https://doi.org/10.15178/VA.2015.133.12-25

Murillo, E., Rujas, I., Sierra, T., Zamora, E., & Azagra, G. (2025). Tactile Cues and Object Use in Multimodal Communicative Behaviors: Parent-Infant Interactions From 9 to 12 months of Age. *Infancy: the official journal of the International Society on Infant Studies*, *30*(4), e70038. https://doi.org/10.1111/infa.70038

Musnir, N., & Sumantri, S. (2019). *Development of Material Learning Based Multimedia for Early Childhood Inclusion Education*. https://doi.org/10.2991/ICPEOPLEUNNES-18.2019.54

Muthanje, A. K. (2023). Mainstreaming Instructional Materials for Early Childhood Education and its Influence on Children's Participation Rates in Public Primary Schools in Embu County, Kenya. *Journal of Studies in Education*, *13*(2), 30. https://doi.org/10.5296/jse.v13i2.20767

Pacini-Ketchabaw, V., Kind, S., & Kocher, L. (2016). *Encounters With Materials in Early Childhood Education*. https://www.taylorfrancis.com/books/mono/10.4324/9781315743257/encounters-materials-early-childhood-education-veronica-pacini-ketchabaw-sylvia-kind-laurie-kocher

Pant, I., Sharma, L. K., & Sharma, M. K. (2024). Use of Audio-Visual Teaching Learning Materials in Facilitating of Health Education in Early Childhood Development Centers, Pokhara, Nepal. *Journal of Health Promotion*, *12*(1), 55–66. https://doi.org/10.3126/jhp.v12i1.72697

Rahman, T., & Nuraini, Y. (2023). Analysis of the Use of Learning Media in Early Childhood Education. *Scientia (Panamá)*. https://doi.org/10.51773/sssh.v2i2.244

Rohibni, R., Rokhmawan, T., Sayer, I. M., & Fitriyah, L. (2022). The Variety of Mathematics Learning Media for Early Childhood in Improving Basic Mathematics Ability. *Bulletin of Science Education*, *2*(3), 102. https://doi.org/10.51278/bse.v2i3.427

Rosalianisa, R., Purwoko, B., & Nurchayati, N. (2023). Analysis of Early Childhood Fine Motor Skills Through the Application of Learning Media. *IJORER*, *4*(3), 309–328. https://doi.org/10.46245/ijorer.v4i3.307

Roziah, R. (2019). *Pengembangan media pembelajaran berbasis sensory carpet untuk pemahaman panca indera anak usia 1-2 tahun* (Doctoral dissertation, Universitas Islam Negeri Maulana Malik Ibrahim).

Rupnidah, R., & Suryana, D. (2022). Media Pembelajaran Anak Usia Dini. *Jurnal PAUD Agapedia*, *6*(1), 49–58. https://doi.org/10.17509/jpa.v6i1.48199

Salna, I., Rahmadanti, L., Sa'adah, N., Fatimah, F., Khadijah, K., & Putri, H. A. (2024). Mengembangkan Sosial Emosional Anak Usia Dini Melalui Bermain. *Ta'rim*, *5*(3), 63–71. https://doi.org/10.59059/tarim.v5i3.1340

Servelin, J. M. da S. B., Oliveira, S., & Conceição, A. de N. (2019). Revisão bibliográfica sobre espaços e materiais para a Educação Infantil (2019-2023). *Revista Do Instituto de Políticas Públicas de Marília*, *10*, e024008. https://doi.org/10.36311/2447-780x.2024.v10.e024008

Sudarsana, I. K., Suhardiana, P., Oktarina, P., & Dantha, N. K. (2020). *Flashcard As A Learning Media For Early Childhood*. https://doi.org/10.4108/EAI.20-6-2020.2300615

Sumarmi, S., & Afendi, A. R. (2022). Improving Learning Creativity in Early Childhood Through Learning Media Loose Part: Energetic, Concentrated and Creative. *Journal of Education and Learning Innovation*, *2*(3), 392–398. https://doi.org/10.35877/454ri.eduline1262

Tubele, S. (2023). Multisensory Approach in Speech Therapy for Preschool Children. *To Be or Not to Be a Great Educator*, 815-823. https://doi.org/10.22364/atee.2022.55

Zahra, M. F. A., Wardono, P., & Maharani, Y. (2019). Studi Preferensi Tekstur Pada Permukaan Lantai Dalam Menunjang Perilaku Bermain Anak Di Sekolah Montessori. *Idealog: Ide dan Dialog Desain Indonesia*, *4*(2), 119-126.