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Early Childhood Fine Motor Development Profile through Flannel-Based Ocean Habitat Educational Media: Adaptation of PDMS-2 Indicators

Yelsa Aulia*, Mayrisa Br Tarigan, Najwa Shifa Lubis

Universitas Negeri Medan, Medan, Indonesia

ABSTRACT

Fine motor development in early childhood requires manipulative stimulation that trains finger coordination, hand control, and visual-motor integration. However, motor assessments in early childhood education are often still general and lack structured manipulative activities. This study aimed to describe children's fine motor development through the use of flannel-based Ocean Habitat educational media adapted from the fine motor indicators of the Peabody Developmental Motor Scales Second Edition (PDMS-2). A qualitative descriptive approach was used with 10 children aged 5–6 years at Pembina Kindergarten. Data were collected through structured observation, micro-motor video documentation, and field notes. The observation instrument covered grasping, visual-motor integration, and object manipulation aspects. The findings showed that Ocean Habitat media effectively stimulated pincer grasp skills, eye-hand coordination, finger stability, and manipulative control of small objects. Activities such as magnetic fishing, hanging flannel objects, and inserting components into slots provided meaningful sensorimotor stimulation. The study concludes that sensory-based manipulative media can support systematic and contextual assessment of fine motor development in early childhood.

ABSTRAK

Perkembangan motorik halus anak usia dini memerlukan stimulasi manipulatif yang dapat melatih koordinasi jari, kontrol gerakan tangan, dan integrasi visual-motorik. Namun, penilaian perkembangan motorik di lingkungan PAUD masih sering dilakukan secara umum dan belum memanfaatkan aktivitas manipulatif yang terstruktur. Penelitian ini bertujuan mendeskripsikan profil perkembangan motorik halus anak melalui media edukatif Ocean Habitat berbasis kain flanel dengan adaptasi indikator Peabody Developmental Motor Scales Second Edition (PDMS-2). Penelitian menggunakan pendekatan deskriptif kualitatif dengan subjek 10 anak kelompok B usia 5–6 tahun di TK Pembina. Pengumpulan data dilakukan melalui observasi terstruktur, dokumentasi video mikro-motorik, dan catatan lapangan. Instrumen observasi mencakup aspek menggenggam, integrasi visual-motorik, dan manipulasi objek. Hasil penelitian menunjukkan bahwa media Ocean Habitat mampu menstimulasi keterampilan pincer grasp, koordinasi mata-tangan, stabilitas gerakan jari, dan kontrol manipulatif benda kecil. Aktivitas memancing magnet, menggantung objek flanel, dan memasukkan komponen ke celah sempit memberikan stimulasi sensorimotor yang bermakna. Penelitian ini menyimpulkan bahwa media manipulatif berbasis sensorik dapat digunakan sebagai sarana penilaian perkembangan motorik halus anak usia dini secara lebih sistematis dan kontekstual.

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*** Corresponding Author:** yelsa.1243113001@mhs.unimed.ac.id

Introduction

Fine motor development is an essential component of early childhood growth because it is closely associated with children's ability to coordinate finger movements, control hand stability, and integrate visual perception with motor responses. These abilities become fundamental foundations for children's readiness in performing various academic and daily life activities such as writing, drawing, arranging objects, buttoning clothes, cutting patterns, and manipulating small objects independently. During the age of 5–6 years, children begin to demonstrate more refined manipulative movements characterized by improved finger dexterity, better object control, and more stable eye-hand coordination (Khaironi, 2018). The development of fine motor skills does not occur automatically but emerges gradually through repeated milestones and biological growth stages (Hurlock, 2015). To fully mature, these capacities require continuous environmental support and interactive learning situations (Santrock, 2020).

Manipulative play activities that involve grasping, pinching, pulling, hanging, arranging, and

inserting objects can stimulate the coordination between sensory perception and movement control. Through these activities, children learn to regulate finger pressure, maintain movement precision, and coordinate visual attention with hand movements simultaneously. From a wider lifespan view, providing early sensorimotor foundations significantly influences independent tool manipulation in later life stages (Papalia & Martorell, 2021).

In early childhood education settings, manipulative activities are commonly integrated into classroom learning through educational play tools and sensory-based games (Mufliharsi, 2017). Learning and teaching vocabulary in the context of foreign and second language learning is considered and experienced both by teachers and students of all ages and grades as a boring and dull facet, particularly in early educational settings. When children face rigid or repetitive tasks, their focus and active participation in physical activities can also decline. However, assessment practices for fine motor development are still frequently conducted in a general manner and tend to focus only on the final results of children's work rather than on the motor processes emerging during activities. Teachers often assess whether children successfully complete tasks without systematically observing movement stability, grasping patterns, visual tracking, or manipulative control shown during play activities. Consequently, variations in children's fine motor behaviors are not optimally identified.

One of the widely recognized instruments for assessing children's motor development is the Peabody Developmental Motor Scales Second Edition (PDMS-2), developed by Folio and Fewell (2000). The instrument evaluates both gross and fine motor domains. In the fine motor domain, PDMS-2 focuses on grasping ability and visual-motor integration, which are closely related to children's finger coordination, movement precision, object manipulation, and eye-hand coordination. The indicators contained in PDMS-2 can help teachers observe children's motor development more systematically and contextually.

Several previous studies have shown that manipulative educational media can support fine motor development in early childhood. Manipulative activities using educational play tools have been found to stimulate finger coordination, movement precision, and object control during learning activities. Structured physical media implementations also encourage systematic neuromuscular progression in early childhood classrooms (Sumantri, 2020). New innovations in sensory sheet platforms have also proven to be highly adaptable for classroom implementations (Fajariani & Suryana, 2023). Nevertheless, most previous studies focused primarily on improving fine motor abilities through play activities, while studies utilizing manipulative media as contextual assessment tools adapted from PDMS-2 indicators remain limited.

In response to this gap, this study developed flannel-based Ocean Habitat educational media as a manipulative sensory activity designed to stimulate and observe children's fine motor behavior more naturally. The media was designed using a marine ecosystem theme involving activities such as magnetic fishing, hanging flannel objects, arranging marine biota, and inserting components into narrow slots. These activities encourage children to coordinate visual attention, finger movements, and manipulative control simultaneously.

The characteristics of flannel media also provide multisensory experiences through tactile texture, visual stimulation, and manipulative interaction with concrete objects. During activities such as pinching, pulling, directing, and stabilizing small objects, children receive tactile and proprioceptive feedback that supports neuromuscular coordination and visual-motor integration. From a sensorimotor perspective, repeated manipulative experiences help strengthen the relationship between sensory input and motor responses, allowing children to gradually develop more precise and controlled movements. Therefore, this study aims to describe the profile of early childhood fine motor development through the use of flannel-based Ocean Habitat educational media with adaptation of PDMS-2 indicators in a contextual and play-based learning environment.

Method

This study employed a qualitative descriptive approach aimed at describing the profile of early childhood fine motor development through manipulative activities using flannel-based Ocean Habitat educational media. The qualitative approach was selected because the study focused on observing children's motor behavior naturally, contextually, and in depth during play activities. Numerical scores and percentages were used only as supporting data to categorize variations in children's motor behavior, while the primary analysis emphasized qualitative interpretation of observational findings.

The study was conducted at Pembina Kindergarten involving 10 children aged 5–6 years in Group B, consisting of five boys and five girls. Participants were selected using purposive sampling

based on children's active participation during classroom learning activities and variations in their early motor abilities identified through preliminary observations.

Ocean Habitat media was developed as a flannel-based Educational Play Tool (Alat Permainan Edukatif/APE) with a marine ecosystem theme. The media consisted of a sea-themed flannel board, marine biota components, magnetic fishing sticks, hanging slots, and small manipulative objects. Manipulative activities included fishing marine objects using magnetic rods, hanging flannel objects, inserting components into narrow slots, and arranging marine objects according to specific positions. These activities were intentionally designed to stimulate finger coordination, visual tracking, object manipulation, and movement precision through concrete sensory experiences.

The observation instrument was adapted from the fine motor domain of the Peabody Developmental Motor Scales Second Edition (PDMS-2), particularly the grasping and visual-motor integration domains. The observations focused on three main aspects: grasping ability, visual-motor integration, and object manipulation. Observation indicators included pincer grasp ability, grip stability, eye-hand coordination, visual tracking, movement control, and precision movement during manipulative activities. The observation scoring rubric used four assessment categories: score 1 indicated that the child was unable to perform the activity, score 2 indicated that the child performed the activity with assistance, score 3 indicated that the child performed independently but inconsistently, and score 4 indicated that the child performed independently and consistently. Developmental achievement categories were classified into Very Well Developed, Developing as Expected, Starting to Develop, and Not Yet Developed based on percentage achievements.

Content validation of the observation instrument was conducted through expert judgment involving two early childhood education experts and one child motor development expert. The validation results indicated that the observation indicators were appropriate for identifying fine motor behaviors during manipulative play activities in early childhood learning settings.

Data collection was conducted over four observation sessions during classroom learning activities using structured observation, micro-motor video documentation, and field notes. Structured observation was used to identify children's motor behavior during manipulative activities, while micro-motor video documentation enabled detailed observation of finger movement patterns, grip stability, hand movement direction, and eye-hand coordination. Field notes were used to record contextual situations, children's responses, and behavioral variations during learning activities. To improve data credibility, method triangulation was conducted by comparing findings from direct observation, video replay analysis, and field-note documentation.

Data analysis was conducted descriptively and qualitatively through several stages, including data reduction, categorization of motor behavior, presentation of children's fine motor development profiles, and interpretation of findings based on PDMS-2 adaptation indicators. Numerical data in the form of scores and percentages were used only to support categorization of developmental variations and were not intended for inferential statistical analysis.

Result and Discussion

Observations during the implementation of flannel-based Ocean Habitat educational media revealed variations in children's fine motor behavior during manipulative play activities. Activities involving grasping, pinching, directing, hanging, and inserting objects elicited observable patterns of finger coordination, visual tracking, and manipulative control among the participants. The learning process also demonstrated differences in movement stability, eye-hand coordination, and object manipulation precision across children.

Table 1. Results of Children's Fine Motor Development

No	Child Initial	Grasping	Visual-Motor Integration	Object Manipulation	Total Score	Percentage	Category
1	AN	4	3	3	10	83.3%	Very Well Developed
2	RF	3	3	2	8	66.7%	Developing as Expected
3	GL	4	4	3	11	91.6%	Very Well Developed
4	MR	2	3	2	7	58.3%	Starting to Develop
5	SA	4	4	4	12	100%	Very Well Developed
6	DK	3	2	2	7	58.3%	Starting to Develop
7	NL	4	3	3	10	83.3%	Very Well Developed
8	FA	2	2	1	5	41.6%	Starting to Develop
9	ZR	3	4	3	10	83.3%	Very Well Developed
10	IM	4	4	4	12	100%	Very Well Developed

The findings showed that most children demonstrated relatively strong fine motor performance, particularly in grasping ability and visual-motor integration. Children categorized as "Very Well Developed" generally demonstrated stable pincer grasp patterns, consistent eye-hand coordination, and controlled manipulative movements during play activities. During magnetic fishing activities, these children were able to maintain stable finger coordination while visually tracking moving marine objects and directing magnetic rods accurately toward target objects.

Children SA and IM demonstrated the most stable manipulative performance throughout the observation sessions. Both children consistently maintained pincer grasp stability while holding magnetic fishing sticks and manipulating small flannel objects. They were also able to coordinate visual attention with hand movements effectively, particularly when inserting marine components into narrow hanging slots. Their hand movements appeared controlled, coordinated, and precise during repetitive manipulative activities.

In contrast, several children categorized as "Starting to Develop" still demonstrated inconsistent manipulative control and unstable finger coordination. Child FA frequently dropped flannel objects while attempting to insert them into narrow slots. Video replay analysis showed that the child tended to use broader palmar grasp patterns rather than isolated finger movements. The child also appeared to perform movements hastily, causing reduced movement precision and unstable object control.

Similarly, child MR demonstrated inconsistent visual tracking during magnetic fishing activities. The child occasionally lost visual focus while following moving target objects and required additional time to adjust hand direction toward the target area. These findings indicate that visual-motor integration develops gradually through repeated sensorimotor experiences and manipulative activities.

The manipulative activities implemented through Ocean Habitat media also revealed the importance of tactile and proprioceptive stimulation in supporting children's fine motor development. During activities involving pinching, hanging, and inserting objects, children received tactile feedback from the texture of the flannel material while simultaneously coordinating finger pressure and movement direction. These sensory experiences helped children regulate movement precision and hand stability during object manipulation. This is in line with previous findings showing that flannel-based media properties effectively attract children's focus and facilitate small muscle coordination (Umar & Suryana, 2022). Comprehensive occupational studies also verify that dynamic object manipulation under tactile variations significantly accelerates finger strength and grip accuracy (Case-Smith, 2013).

From a sensorimotor perspective, the Ocean Habitat media stimulated coordination between sensory perception and motor responses. Magnetic fishing activities required children to maintain visual concentration while adjusting hand movement angles and movement direction toward moving objects. This process involved simultaneous integration between visual attention, proprioceptive awareness, and fine motor control. Children with stronger visual-motor integration were able to stabilize hand movements more effectively while maintaining consistent visual focus on target objects. Early integration between sensory processing and motor outputs is highly required to establish stable neuro-developmental functions in young kids (Ayres, 2005).

The hanging and slot-inserting activities further demonstrated variations in bilateral coordination and finger dexterity among participants. Some children were able to stabilize objects with one hand while coordinating precise insertion movements using the other hand. Meanwhile, children with lower developmental scores still demonstrated difficulties in maintaining movement stability and coordinating hand pressure during manipulative tasks.

The findings support the view that repeated manipulative experiences play an important role in strengthening neuromuscular coordination and movement precision in early childhood. According to sensorimotor theory, concrete manipulative activities involving tactile, visual, and proprioceptive stimulation help strengthen the relationship between sensory input and motor output, allowing children to gradually develop more coordinated and controlled movements.

The use of PDMS-2 adaptation indicators in this study also enabled more systematic observation of children's motor behavior compared to general classroom assessment practices. Teachers were able to identify variations in grasping patterns, visual tracking, movement stability, and object manipulation more specifically during play activities. This finding indicates that manipulative sensory-based media can function not only as learning tools but also as contextual assessment media for observing children's fine motor development in natural classroom settings.

In addition to stimulating motor development, Ocean Habitat activities increased children's engagement and concentration during learning. Children appeared enthusiastic and actively involved throughout the manipulative play sessions. The colorful marine ecosystem theme and tactile characteristics of the flannel material encouraged longer visual attention and active participation during classroom activities. These findings suggest that contextual and sensory-based manipulative media can support both authentic assessment and meaningful play experiences in early childhood education.

Conclusion

This study shows that flannel-based Ocean Habitat educational media can be used as a contextual and systematic tool for describing early childhood fine motor development through adaptation of PDMS-2 indicators. Manipulative activities such as magnetic fishing, hanging flannel objects, and inserting components into narrow slots successfully elicited observable fine motor behaviors, particularly in grasping ability, visual-motor integration, and object manipulation. The findings indicate that children's fine motor development varies across individuals and can be more clearly identified through structured manipulative activities rather than general classroom observation.

The use of sensory-based media also supports children's engagement, attention, and active participation during learning. In addition, PDMS-2 adaptation indicators help teachers observe motor development in a more structured and meaningful way within natural play contexts. Therefore, manipulative play-based assessment is recommended as an alternative approach for early childhood fine motor evaluation in classroom settings.

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