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HANDS-ON ACTIVITIES AND CHILDHOOD MEMORY

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Abstract

Hands-on activities provide many learning opportunities. This study explores how hands-on activities and experiential learning influence memory formation and cognitive development in early childhood. Hands-on activities—rooted in experiential learning theory, social constructivism, embodied cognition, and developmental neuroscience—are understood as multisensory, emotionally engaging experiences that promote deeper comprehension by integrating physical action, cognitive processing, and emotional involvement. Childhood memory develops rapidly during early years through neural development and social interaction, and it is strengthened when children manipulate objects, engage in goal-directed actions, and participate in collaborative, play-based learning. The study is based on evidence from thirty research papers selected from an initial pool of eighty-eight articles identified through Google Scholar, ResearchGate, and SciSpace. Keywords such as 'hands-on learning', 'experiential learning', and 'memory development' guided the search. Inclusion criteria mostly focused on empirical studies published between 2010 and 2025, written in English, and centred on early childhood education. The reviewed studies reveal consistent patterns showing that experiential, activity-based learning enhances memory, attention, executive function, and broader cognitive developments in young children. The review concludes that hands-on, physical activities and experiences are essential for early learning, promoting deeper understanding, greater motivation, and holistic cognitive growth.

Keywords: *Hands-on learning, Childhood memory, Experiential learning, Early childhood education, Cognitive development.*

1. Introduction

1.1. Hands on activities

1.1.1 Concept and Definition of Hands on Activities

According to İnan and İnan (2015), hands-on learning represents the "hands-on, heads-on, and hearts-on" approach to science education, where physical manipulation (hands-on), cognitive engagement (heads-on), and emotional connection (hearts-on) work together to produce deeper and more meaningful learning. In early infancy, this approach goes beyond academics, it cultivates curiosity, independence, and confidence while engaging brain regions involved in sensory integration and executive functioning

1.1.2 Theoretical Foundation

Social constructivism and experiential learning theory (Kolb, 1984) are major sources of inspiration for hands-on learning. These theories believe that knowledge is assimilated by doing, reflecting, and engaging. In early education, play-based and manipulative activities allow children to assimilate abstract concepts through physical experience. Umeji (2025) found that children's critical thinking, inquiry abilities, and evidence-based reasoning all increased when individualized and hands-on science instruction was incorporated. This finding supports the notion that learning via experience improves comprehension and retention. Likewise, Sadi and Çakıroğlu (2011) discovered that activity-enriched instruction enhanced both science achievement and the development of more favorable attitudes toward learning, indicating that intrinsic motivation is fostered by experiential involvement.

Additionally, Loucks et al. (2017) found that young children are more likely to interpret actions and events according to their goal structure rather than through mere repetition, indicating that actively participating in tasks enhances their ability to organize and retain learning experiences. These results support the idea that hands-on activities allow children to engage with information on both cognitive and conceptual levels, changing abstract concepts into tangible knowledge.

1.1.3 Types of Hands on Activities

1.1.3.1 Cognitive and scientific Exploration. Hands-on activities allow children to investigate, explore, and form conclusions. Within scientific learning environments, they

promote the cultivation of observational skills, hypothesis testing, and experimentation. Umeji (2025) and Sadi & Çakıroğlu (2011) discovered that these activities encourage inquiry-based learning, helping children to remember concepts for a longer period and apply them to different contexts.

1.1.3.2 Physical and Sensorimotor Development. Experiencing hands-on activities often entails the use of both fine and gross motor skills, which play a key role in preparing students physically for academic tasks. Mata et al. (2023) revealed that engaging in fine-motor activities, like cutting and threading, led to improvements in pencil grip and readiness for handwriting. Similarly, Bernal and Sholl-Franco (2023) discovered that incorporating sound and movement into early education boosted sensorimotor coordination, self-regulation, and spatial awareness. These results imply that physical engagement is not only a bodily function but also a cognitive process, establishing a basis for attention and executive functioning.

1.1.3.3. Creative and Artistic Engagement. Engaging in creative, practical activities encourages both imagination and problem-solving skills. Bibire et al. (2024) found that hands-on artistic projects markedly improved preschoolers' creativity, curiosity, and self-reliance. By working with various materials like clay, paper, and recycled items, children practice divergent thinking, converting imaginative ideas into tangible expressions, which is crucial for their early cognitive and emotional growth

1.1.3.4 Emotional and Social Engagement. Experiential learning inherently fosters collaboration, empathy, and a sense of self-efficacy. The 3Hs framework proposed by İnan and İnan (2015) highlights the hearts-on aspect; emotional engagement and joy in exploration, as vital for ongoing motivation. Likewise, Shaheen et al. (2024) found that teaching methods involving interactive, hands-on activities enhanced attention, perception, and memory retention in preschoolers. When children engage in cooperative tasks, they not only build cognitive skills but also develop social-emotional abilities essential for future success.

In general, hands-on activities embody a comprehensive approach to early education that combines physical interaction, emotional involvement, and inquisitive thinking. By stimulating various senses and cognitive processes at the same time, these activities support

children in developing not just knowledge, but also the self-assurance and creativity to apply it. The studies reviewed collectively support the idea that hands-on involvement acts as both a teaching method and a developmental resource, connecting experience with comprehension. Consequently, hands-on learning establishes the groundwork for meaningful education, where thought, emotion, and action overlap to foster enduring learning results.

1.2 Childhood Memory

Childhood memory refers to how young children encode, store, and retrieve information. This forms the basis for learning and development. Early childhood involves rapid neural growth, especially in the hippocampus and medial temporal lobes. This rapid neural growth is responsible for memory formation (Newcombe et al., 2024). Studies show that memory development is supported by active, hands-on activities (Brezack et al., 2023; Cameron & Xu, 2011; Ratner & Foley, 2020). Memory in early childhood is most effectively developed through meaningful, physical, and interactive learning experiences (Hollan, 2024; Hartman et al., 2000).

1.2.1 Concept and Definition of Childhood Memory

Childhood memory is the developing system by which infants and young children form, maintain, and retrieve mental representations of experiences, events, objects, and actions. Early memory traces in infants are fragile, but they grow stronger and more specific as the brain develops (Newcombe et al., 2024). Environmental input, multisensory engagement, and social interaction all shape this development. Young children rely more on category-based knowledge at first, but they gradually shift to detailed episodic recall as their cognitive systems develop (Persaud et al., 2019). Metacognitive skills—like monitoring and evaluating memory—also help improve recall accuracy (Gardier & Geurten, 2024). Childhood memory changes with age, and this change is influenced by biological and contextual factors.

1.2.2 Theoretical Foundation of Childhood Memory

1.2.2.1 Embodied Cognition Theory. The Embodied Cognition Theory states that cognitive processes, including memory, are grounded in bodily interactions with the environment. Numerous studies have shown that the use of gestures, active participation, object manipulation, and hands-on tasks enhances memory formation (Cameron & Xu, 2011; Hsiao et al., 2025; Brezack et al., 2023). Goal-directed actions produce outcomes that

strengthen encoding and retrieval. These goal-directed actions are more effective than passive observation (Ratner & Foley, 2020).

1.2.2.2 Information Processing Theory. The Information Processing Theory states that memory development is a gradual improvement in attention, working memory, processing speed, and executive function. Studies in early childhood settings show that interactive, activity-based instruction enhances working memory retention and attentional control (Shaheen et al., 2024; Alhakami, 2019). Research on digital screen exposure similarly shows that processing demands influence memory recall and attention (Jagirdar, 2025).

1.2.2.3. Neuroconstructivist and Developmental Neuroscience Perspectives. Developmental neuroscience emphasises the maturation of neural systems underlying memory. Evidence shows that memory abilities expand as structures such as the hippocampus and medial temporal lobes develop (Newcombe et al., 2024). This maturation explains the shift from generalised memory in early childhood to detailed episodic recall as children grow older.

1.2.2.4. Sociocultural Theory. Sociocultural perspectives emphasise the role of guided participation, social interaction, and collaborative learning. Teachers' use of play-based activities and interactive instructions enhanced children's memory and cognitive skills (Ghosh, 2024; Henriksson et al., 2023; Priyantini & Yusuf, 2020).

1.2.2.5. Metacognitive Development Theory. Metacognitive development theories focus on children's growing ability to monitor, evaluate, and regulate their own memory. Longitudinal evidence shows that metacognitive monitoring becomes more accurate around 3.5–4.5 years of age. This predicts later episodic memory performance (Gardier & Geurten, 2024; Geurten & Willems, 2016).

1.2.2. Types of Memory

1.2.2.1. Episodic Memory. Episodic memory is the ability to recall specific experiences. Studies show that children's episodic memory is enhanced when they participate in tasks or when the events are goal-oriented (Brezack et al., 2023; Ratner et al., 2019).

1.2.2.2 Semantic Memory. Semantic memory includes general knowledge and conceptual information. Early childhood recall is strongly influenced by category expectations, as young children tend to rely on prototype-level representations (Persaud et al., 2019).

1.2.2.3 Procedural Memory. Procedural memory involves remembering actions and motor skills. Hands-on activities such as weaving, fine motor practice, and sensorimotor workshops strengthen procedural memory (Ihsanti et al., 2024; Mata et al., 2023; Bernal & Sholl-Franco, 2023).

1.2.2.4 Working Memory. Working memory enables children to temporarily hold and manipulate information. Interactive, exploratory, and collaborative learning experiences improve working memory (Shaheen et al., 2024; Alhakami, 2019).

1.2.2.5. Sensorimotor Memory. Sensorimotor memory forms through tactile and physical engagement. Studies show that touch, movement, and active manipulation of objects create strong memory traces and enhance imaginative and cognitive processes (Hollan, 2024; Tsutsui et al., 2022).

1.2.2.6. Social and Emotional Memory. Emotionally engaging experiences—such as play, storytelling, and movement activities—improve recall accuracy. Multisensory and emotionally meaningful learning contexts create durable memory traces (Holstermann et al., 2010; Bernal & Sholl-Franco, 2023).

2. Reviews of Literature

A study aimed to investigate whether integrating gesture recognition technology with memory-based learning strategies could enhance preschoolers' cognitive and motor development (Hsiao et al., 2025). The sample consisted of 67 preschool children aged 5 to 6 years from an urban kindergarten in Taiwan, and the study employed a quasi-experimental pretest–post-test control group design. The participants were divided into an experimental group that learned English vocabulary through gesture-based interactive technology and a control group that used traditional memory strategy activities without technology. Both groups received instructions based on Oxford's four-step memory strategy — creating mental linkages, using images and sounds, reviewing, and employing actions — across six sessions. Learning performance, motor skills, and executive function were assessed before and after the intervention. The results showed that the experimental group outperformed the control group across all measures. They demonstrated higher vocabulary recall, improved stability and movement motor skills, and stronger working memory performance. The findings indicate that combining hands-on bodily movement with cognitive strategies through

interactive technology can enhance preschoolers' learning effectiveness, motor coordination, and executive functioning.

A study aimed to examine how exposure to digital screens influenced early childhood memory, learning, and creativity (Jagirdar, 2025). Using a qualitative narrative inquiry approach, the researchers collected data from 15 participants — 12 parents and 3 preschool teachers — who shared their observations of children's screen-related behaviours and cognitive functioning. Focus was placed on how digital media use affects memory recall, attention, and creative engagement among young children. Data was gathered through interviews and storytelling sessions that explored the participants' perceptions of both the benefits and drawbacks of screen exposure. The results indicated that while digital content allowed children to quickly absorb factual information, it also hindered everyday memory recall tasks, such as remembering routine tasks or locating personal items. Participants noted that screen time often replaced active, hands-on play. This led to reduced opportunities for imaginative and social interaction. However, when guided by adults or used interactively, screens could support creative expression and learning. Screen time has a dual impact — it both enables and limits cognitive development. The importance of balanced, supervised digital engagement to support healthy memory and creativity in early childhood is emphasised.

The study by Umeji (2025) aimed to investigate the impact of personalised learning and hands-on science engagements on the development of scientific inquiry skills among early childhood care and primary education students. Conducted in Anambra State, Nigeria, the research adopted a descriptive survey design involving 143 participants from diverse backgrounds. Data were collected using a validated, self-structured questionnaire distributed through Google Forms, with responses measured on a Likert scale. The data were analysed using descriptive statistics and ANOVA to determine group differences. Findings revealed that personalised learning significantly enhanced learners' critical thinking, hypothesis formulation, experimental design, and evidence-based reasoning. Similarly, hands-on science activities strengthened students' problem-solving abilities, inquiry skills, and knowledge retention through experiential learning. Overall, the study emphasized that integrating personalised and practical learning experiences promotes holistic cognitive development and supports long-term learning outcomes in young children.

The study by Bibire et al. (2024), titled Stimulating Preschoolers' Creative Imagination Through Hands-On Practice, aimed to enhance creative imagination in preschoolers through hands-on, practice-based learning. Conducted with 29 children aged 5–6 years in Romania, the study adopted an experimental formative methodology. Children engaged in artistic, manipulative, and exploratory activities that encouraged discovery and independent thinking. Results revealed that hands-on learning significantly improved creative motivation, curiosity, self-confidence, and problem sensitivity. The study concluded that tactile and experiential learning fosters both imaginative thinking and cognitive-emotional growth, highlighting its value for creative development in early education.

A study focused on investigating how metacognitive skills develop between the ages of 2.5 and 4.5 years, and how these early abilities influence later memory performance (Gardier & Geurten, 2024). The researchers assessed 69 children. The first assessment happened when the children were about 32 months of age. They were then tested at one-year intervals across three sessions. Using a longitudinal design, the children participated in tasks measuring metacognitive monitoring and metacognitive control. In the final test, an episodic memory test involving story recall was administered. The results revealed that both metacognitive monitoring and control significantly improved across the three sessions, with children beginning to show above-chance performance around 3.5 years of age. Metacognitive monitoring ability was also found to be significantly associated with memory performance at 4.5 years. This suggests that early awareness of one's memory accuracy predicts later success in episodic memory tasks.

The study aimed to explore how participation in structured early childhood education (ECE) programs affected the cognitive and social development of children aged 3 to 6 years in India (Ghosh, 2024). It sought to assess improvements in problem-solving skills, language acquisition, emotional intelligence, and cooperative behaviour. The population consisted of 100 children from 5 different preschools. Parents and teachers were also interviewed as part of this study for further insights into the children's growth. A mixed-method design was employed, combining both quantitative and qualitative data. Cognitive tests and behavioural observations of social interactions, and interviews and surveys with adults, provided much information about developmental changes. The results revealed that participation in ECE programs had a positive impact on children's developmental outcomes, with children who

attended the ECE programs scoring 20% higher in problem-solving tests, showing enhanced vocabulary and language skills, and demonstrating greater cooperation, empathy, and sharing behaviours in social settings.

Another study sought to understand the deep interconnection between tactile experience, memory, and imagination (Hollan, 2024). The study aimed to examine how hands — through touching, holding, and manipulating items — serve as powerful channels for shaping both memory and imaginative processes. Hollan adopted a theoretical and phenomenological approach - reflecting on experiences of touch and manual engagement as foundational to how individuals remember and imagine. There was a focus on universal cognitive and sensory experiences. Through philosophical analysis and reflection, Hollan concludes that tactile interactions provide a sensory grounding for memory, anchoring imagination in reality. The study highlights how memories involving hands create a unique connection between individuals and the environment, thus emphasising that touch not only preserves embodied experiences but also fuels creative and emotional understanding.

One research study focused on determining the effect of weaving activities using coconut leaves on the development of fine motor ability and the identity of children aged 5-6 years (Ihsanti et al., 2024). These children had issues with their fine motor skills. Their hands were stiff when they held a pencil. This research study used a pre-experimental design with a pre-test and a post-test. The sample consisted of 29 students. They were selected using random sampling techniques. Based on the quantitative data, it was found that weaving activities can influence the development of children's identity, confidence, and fine motor ability.

The study provides a comprehensive review of research on how memory develops from infancy through early childhood (Newcombe et al., 2024). Existing behavioural and neuroscientific evidence was reviewed to explain how infants and young children form, store, and retrieve memories, and how these processes develop with age. The authors employed a literature review method, using findings from numerous studies about developmental psychology and cognitive neuroscience. The population included infants and children from early childhood age groups. The key findings highlight that infants are capable of forming and retaining memory traces earlier than believed. However, these memories are often fragile and not always accessible later in life. As children grow, their memory systems gradually

shift from generalised semantic or procedural memory toward more specific and detailed episodic memory. This is due to the maturation of neural structures such as the hippocampus and medial temporal lobes.

The study by Shaheen, Ullah, and Zafar (2024), titled Effect of Teachers' Instruction on Learners' Cognitive Skills, Attention, Perception and Memory in Early Childhood Education, examined how instructional methods affect cognitive processes such as attention, perception, and memory among preschoolers. Using a quantitative correlational design, data were gathered from 200 early learners and 40 teachers in Punjab, Pakistan. Results showed that interactive, activity-based instruction had a strong positive effect on learners' memory retention, focus, and perceptual accuracy, whereas teacher-centred approaches were less effective. The study concluded that learner-centred, multisensory instruction enhances early cognitive development and recommended that teachers adopt hands-on, exploratory approaches to strengthen attention and memory in early education.

One study explored whether and how experiential learning strategies in kindergarten settings lead to developmental changes in children. It also focused on exploring teachers' perceptions around the use of such methods (Amalia, 2023). The research involved a survey of 250 kindergarten teachers aged between 21 and 54 years from multiple kindergartens in Romania. The study combined a literature review of experiential learning theory with a local empirical component - teachers completed a questionnaire addressing their usage of experiential learning approaches and their perceptions of the benefits and drawbacks of these methods. The results revealed that about 90% of respondents emphasised the importance of experiential learning strategies for young children's cognitive, physical, emotional, and social development, listing play, research, and experimentation as key strategies. The respondents reported that children participating in such exploratory activities were more motivated, engaged, and confident, and that the parents also provided positive feedback when such activities were used. Some disadvantages were noted, but the majority viewed experiential learning as a good way to foster meaningful, child-initiated exploration.

The study by Bernal and Sholl-Franco (2023), titled Sound and Movement Hands-On Workshop as a Sensorimotor Stimulation Tool During Child Development, evaluated how sound and movement-based hands-on workshops can enhance sensorimotor and cognitive development in early childhood. Conducted through interactive workshops in early education

settings, children participated in rhythmic, kinesthetic, and auditory activities using traditional and improvised instruments. Findings indicated that multisensory, movement-based learning improved motor coordination, spatial awareness, and emotional expression. Children showed increased attention, self-regulation, and social interaction. The study concluded that sound and movement workshops provide effective sensorimotor stimulation and should be integrated into curricula to foster holistic growth in early learners.

The study by Brezack et al. (2023) examined the effects of active versus observed instruction on action learning and long-term memory in toddlers. The researchers aimed to determine whether children learn and retain actions better through self-performance or observation. Using a within-subjects experimental design, the study included 46 toddlers aged 22–26 months. Each child experienced two learning conditions: one involving active participation and another based on observation. Learning and generalisation were tested immediately, with long-term memory assessed one year later among 26 participants. While short-term learning did not differ significantly, follow-up results showed a substantial long-term memory advantage for active participation (OR = 5.23). The study concluded that hands-on engagement plays a crucial role in memory consolidation, reinforcing the value of embodied learning for sustained cognitive development.

The study aimed to explore how preschool teachers integrate scientific content into play activities with young children. They focused on how shifts occur between the imaginative and the scientific dimensions of activities in the classroom (Henriksson et al., 2023). The population consisted of one Swedish preschool unit with children aged 1 to 4 years old and two preschool teachers and carers responsible for the activities. The study collected data from video observations of small groups (2-4 children) participating in play activities. The study used a qualitative design – video observations of the preschool classroom over two months, followed by transcription and qualitative content analysis of the sequences where the teacher initiated shifts between imaginative play and scientific content. The results showed that the preschool teacher enacted the shift between imaginative play and scientific content through changes in voice and bodily expression. The authors conclude that when the teacher is responsive in play, scientific content and child-initiated play can be integrated with one another.

The study by Mata et al. (2023), titled Influence of Fine Motor Activities to Develop Pencil Grip, examined how fine motor activities contribute to the development of pencil grip and pre-writing skills in preschoolers. Employing a mixed-methods design, the researchers combined quantitative assessment, qualitative observation, and teacher-parent feedback. Preschool participants engaged in exercises such as cutting, threading, molding clay, and drawing to improve hand–eye coordination. Findings showed significant improvement in pencil grip and handwriting readiness compared to control groups. The study concluded that fine motor development is a key foundation for early literacy and recommended daily integration of tactile, manipulative activities in preschool routines.

One study focused on examining how active object manipulation — that is, children handling and interacting with objects — affects visual object learning and recognition (Tsutsui et al., 2022). The researchers wanted to determine whether active engagement with objects enhances learning efficiency, especially when limited visual examples are available. Using an egocentric vision approach, the study analysed first-person video recordings collected from toddler-worn cameras during play sessions involving toy manipulation. The image data were categorised based on whether the object was being held by the child, held by a parent, or not handled at all. Machine learning classifiers were trained on these different conditions to assess how hand involvement influenced recognition performance. The results showed that visual object learning was more effective when the images included instances of active hand manipulation — either by child or parent — as compared to when the objects were observed passively. The study concluded that active interaction with objects plays a crucial role in supporting early learning and memory, as it provides more informative visual and motor experiences.

The study by Gordon et al. (2021), titled Give Yourself a Hand: Gesture and Working Memory in Preschool Math, explored how gesture use and working memory contribute to mathematical understanding in preschoolers. The study involved 81 Head Start children from low-income backgrounds, providing insight into diverse early learning contexts. Participants were videotaped performing a modified Give-N task to assess number comprehension, along with two tasks measuring verbal and visuospatial working memory. Results indicated that both gesture use and working memory capacity correlated positively with math performance. However, after controlling for age, gesture use was no longer significantly associated with

working memory, suggesting developmental mediation. The study concluded that gestures help reduce cognitive load and facilitate conceptual understanding, highlighting their universal role in supporting early mathematical reasoning.

One study examined how literacy-based activities and read-aloud sessions contributed to the development of receptive language skills among young children (Priyantini & Yusuf, 2020). The study involved a sample of 115 children drawn from 54 early childhood education institutions in Indonesia. A quantitative correlational design with a survey approach was employed, and the data was collected through structured observations and analysed using multiple regression in SPSS. The results revealed that both literacy and read-aloud activities had positive effects on children's receptive language abilities. Literacy activities alone enhanced receptive language, while read-aloud activities had an even stronger impact. Together, these two factors accounted for 55.5% of the variance in receptive language skills. These results emphasise the importance of engaging children in interactive literacy and storytelling experiences. This will support their language comprehension and early communication development.

The study by Ratner and Foley (2020) explored how goals and outcomes influence young children's memory for actions, focusing on when self-enactment effects occur. Across three experiments with children aged 4–6 years, the researchers compared memory for goal-directed, outcome-producing actions versus purposeless ones. In the first two experiments, source memory and free recall were tested after participation in game-like activities. Results showed that children remembered their own actions significantly better than others', but only when the actions were goal-directed and produced tangible outcomes. The third experiment confirmed that the presence of an outcome was the key factor enhancing memory. The study concluded that goal-oriented actions strengthen encoding and retrieval by making experiences more meaningful, reinforcing the educational value of purpose-driven, hands-on activities in early learning.

The study by Alhakami (2019) explored the impact of classroom-based activities on the development of working memory and social skills in preschool-aged children. Recognising that working memory—critical for academic and emotional growth—develops rapidly in early childhood, the research aimed to determine whether structured, interactive classroom experiences could enhance this process. Preschool participants engaged in group-

based activities that fostered peer collaboration and teacher-guided interaction. The methodology focused on observing how social participation and cooperative learning shaped cognitive and behavioural outcomes. Findings revealed that active classroom engagement significantly improved children's working memory, self-regulation, and problem-solving abilities. The study concluded that structured play and interactive environments are vital for strengthening working memory, underscoring the importance of social learning contexts in early cognitive development.

One study investigated how the use of category knowledge shapes children's memory performance and how this effect evolves with age (Persaud et al., 2019). The researchers investigated whether preschool-aged children relied more on categorical or item-specific information when they were recalling objects. The researchers used a computational modelling approach and compared three models of memory recall: the Prototype model, which assumed that children recall based on category-level information; the Target model, which assumed that recall is based on individual item features; and the Integrative model, which combined both category- and item-specific cues. Preschool children participated in tasks in which they encoded and recalled items that varied in category familiarity. The researchers assessed how category expectations guided memory reconstruction. The results showed that the Prototype model was the best at explaining the majority of preschoolers' recall patterns, suggesting that younger children rely heavily on general category knowledge rather than detailed item-specific memory. Even in trials where children demonstrated individuating behaviours — such as labelling items — the Prototype model still provided the best explanation. As the children grew older, there was a developmental shift towards greater integration of both category and item information. The findings highlight that category expectations strongly shape early memory processes and that developmental changes in how children use prior knowledge play a key role in the development of memory accuracy.

The study by Ratner et al. (2019), titled Kindergarten Children's Event Memory: Action Prediction in Remembering, investigated how predicting actions and outcomes before performing them influences event memory in young children. The study involved 44 kindergarteners aged 5.5–7.1 years, who participated in hands-on tasks requiring them to predict actions or object use in achieving outcomes. Results indicated that action prediction enhanced recall accuracy more than object prediction ($F(1,15) = 5.67$, $p < .05$, $\eta^2 = .28$). The

study concluded that anticipating and enacting goal-directed actions strengthens memory encoding by helping children mentally organise events around causal goals, improving long-term recall.

One paper aimed to identify and discuss learning activities that effectively enhance cognitive development during early childhood (Amalia & Khoiriyati, 2018). The authors focused on understanding how play-based and socially interactive learning experiences can foster a child's intellectual and cognitive abilities. Existing literature and educational practices were reviewed to highlight strategies that stimulate cognitive growth. The population studied comprised young children in the early developmental stages. Results showed that game-based learning and social interaction activities enhance children's engagement, curiosity, and cognitive skill development. The authors concluded that structured play, creative games, and interactive activities with peers and parents are effective tools in promoting optimal cognitive development in early childhood.

The study by Loucks et al. (2017) investigated how children represent and imitate complex sequences of actions, focusing on whether memory and imitation are organised by event sequence or goal structure. Integrating theories of action segmentation, memory, and imitation, the researchers examined how children encode and reproduce observed behaviours. Children were randomly assigned to learn novel event sequences either through hands-on interaction or storybook presentation. Findings indicated that children's memory representations prioritised goal structure over the precise order of actions, suggesting they recalled and imitated actions based on purpose rather than chronology. The study concluded that early cognitive systems organise memory around goals and intentions, facilitating efficient imitation and supporting social-cognitive development in early childhood.

The study by Geurten et al. (2016), titled Metacognition in Early Childhood: Fertile Ground to Understand Memory, explored how metacognitive monitoring and control develop during early childhood and influence memory performance. The researchers examined whether children aged 3–9 years apply heuristics such as fluency and distinctiveness to guide recall. In one experiment, children studied lists of pictures and words, later completing recognition tests. Findings showed that even preschoolers used expectations about memorability to guide recall, though older children applied these strategies more efficiently. The study concluded that metacognitive abilities emerge as early as age four and grow more

refined over time, highlighting their role in supporting adaptive learning and memory regulation.

The study by İnan and İnan (2015), titled 3Hs Education: Hands-On, Heads-On, and Hearts-On Science Education, aimed to integrate three dimensions of learning—hands-on (active engagement), heads-on (cognitive inquiry), and hearts-on (emotional connection)—to create a holistic framework for science education in preschool. Conducted in a Turkish preschool, the research employed an interpretivist qualitative design using ethnographic methods. Data were gathered through classroom observations, teacher interviews, children's work samples, and field notes over two and a half months. Participants included pre-schoolers and teachers who collaboratively engaged in inquiry-based projects, such as the "Earthworms Project." Teachers facilitated learning through guided questioning and exploration. Results showed that integrating these three dimensions fostered curiosity, scientific inquiry, and emotional engagement. The study concluded that multi-dimensional approaches combining practical experimentation, reasoning, and affective involvement enhance both motivation and deep conceptual understanding in early learners.

The study by Cameron and Xu (2011) examined how different types of gestures—specifically representational and pointing gestures—affect memory recall and verbal communication in preschool children. The researchers hypothesised that gesturing would improve children's ability to remember and verbally express information about a previously learned story. The study involved 30 preschoolers (19 boys and 11 girls) aged 49–65 months (mean = 58 months) enrolled in a preschool in the eastern United States. Participants were divided into groups: one used representational or pointing gestures while retelling a story, while the control group kept their hands still. Each child recalled details from a story involving ten farm animals, their sounds, and associated actions. Memory recall was measured by the number of correct details reproduced in order. A one-way MANOVA revealed a significant difference among groups, $F(6,50) = 8.60$, $p < .001$, $\eta^2 = 0.51$. Children who used gestures recalled significantly more details than those who did not. The results demonstrated that gestures enhance memory retrieval by reducing cognitive load and supporting expressive communication among preschoolers.

The study by Sadi and Çakıroğlu (2011), titled Effects of Hands-On Activity Enriched Instruction on Students' Achievement and Attitudes Towards Science, sought to determine

how activity-based learning influences students' academic achievement and attitudes toward science compared to traditional instruction methods. Conducted with middle school students in Turkey, the study used a quasi-experimental design involving experimental and control groups. The experimental group received science instruction enriched with practical, inquiry-based activities, while the control group was taught using conventional lecture-based approaches. Data were collected using a science achievement test and an attitude toward science scale administered before and after the intervention. Statistical analyses, including ANCOVA, were used to compare post-test results while controlling for pre-test differences. The findings revealed that students in the hands-on activity group demonstrated significantly higher academic achievement and developed more positive attitudes toward science learning than those in the control group. Moreover, students exposed to hands-on instruction showed increased motivation, conceptual understanding, and retention of scientific knowledge. The study concluded that experiential learning strategies enhance both cognitive and affective outcomes, fostering long-term engagement and critical thinking in science education.

One study focused on examining how hands-on learning experiences in science education affected students' interest, enjoyment, and emotional engagement (Holstermann et al., 2010). The researchers sought to understand whether physically engaging with materials and performing experiments could enhance situational interest more effectively than traditional, observation-based instruction. The population consisted of over 400 German secondary school students aged 10 to 17 years. These students participated in biology classes that included both hands-on and non–hands-on learning components. The method employed a quantitative experimental design, in which the students engaged in various biology lessons — some involving active, hands-on experimentation, such as dissection, and others involving only observation or theoretical instruction. Data was collected through standardised questionnaires assessing the students' situational interest, emotional reactions, and perceptions of learning. The results showed that hands-on activities increased the students' situational interest and enjoyment as compared to more passive learning experiences. However, the effectiveness varied depending on the nature of the activity — students reported the highest interest when the activities were interactive, novel, and directly related to real-life contexts. The study also found that while hands-on tasks involving living organisms generated strong emotional responses, these experiences tended to heighten engagement.

Holstermann, Grube, and Bögeholz (2010) concluded that incorporating well-designed, hands-on activities can enhance motivation and interest in science learning, especially when emotional engagement is managed appropriately.

A study by Hartman et al. (2000) investigated how active participation in occupations influences children's memory recall compared to passive observation. Grounded in the principles of occupational therapy, the researchers examined whether performing an activity ("hands-on occupation") led to stronger memory encoding than merely watching a demonstration. Children were randomly assigned to either engage directly in an occupational task or observe an adult completing the same task. Findings indicated that children who actively participated demonstrated significantly better recall of the task's steps and details than those who only observed. This suggests that physical engagement strengthens cognitive processing by integrating sensory, motor, and memory systems. The study concluded that hands-on participation enhances memory performance, supporting the occupational therapy premise that active "doing" facilitates learning and cognitive development in children.

3. Methodology

AIM: The purpose of this paper is to evaluate and compile evidence on how experiential learning activities affect memory and cognitive development in early childhood education.

The paper focuses on understanding how children's comprehension, retention, and general learning outcomes are impacted by experiential and activity-based teaching approaches. Relevant literature was obtained from Google Scholar, ResearchGate, and SciSpace by utilizing the keywords "hands-on learning," "experiential learning," "activity-based learning," "early childhood education," and "memory development." The investigation mostly concentrated on peer-reviewed journal publications released from 2010 to 2025, composed in English, and specifically pertaining to early childhood or primary education. Research that included older learners, non-empirical articles, and materials that were not peer-reviewed was omitted to ensure quality and relevance.

Thirty out of the eighty-eight studies that were found in the initial search were deemed eligible based on their titles, abstracts, and relevance to the research topic.

These studies used a variety of research techniques, including experimental, ethnographic, and correlational designs, and represented a range of geographical areas, including Nigeria, Turkey, Pakistan, Romania, and the United States.

Key information from each article, including the author, year, research objectives, population, methodology and results, has been systematically summarized and compared to identify patterns and themes throughout the studies, with the emphasis on how practical activities contribute to memory formation, attention regulation and overall cognitive development.

4. Discussion

The literature reviewed shows a clear pattern: hands-on learning plays a major role in strengthening memory and supporting overall cognitive development in early childhood. Across different study designs—ranging from experiments with toddlers to observations in preschool classrooms—active participation consistently emerges as a key factor in how children take in, store, and recall information. Research on action performance and imitation repeatedly demonstrates that children remember activities they carry out themselves better than those they only watch. This effect is even stronger when the actions are purposeful or lead to a concrete outcome. Together, these findings highlight that memory in early childhood is closely tied to physical engagement and motor activity, rather than being a purely mental process.

The review also shows that hands-on experiences support several other areas of development. Tactile and exploratory activities help build early metacognitive awareness, problem-solving skills, executive functioning, and fine motor abilities. Studies focusing on gesture use show that simple movements can lighten cognitive load and make it easier for children to express and organise their thoughts. Playful exploration, science activities, and creative tasks tend to increase children's motivation and curiosity, helping them stay focused and deepen their understanding. Overall, these findings reinforce the idea that hands-on learning aligns naturally with how young children make sense of the world—through touching, exploring, imagining, and interacting with others.

The research also points to the fact that children form stronger memories when learning happens in multi-sensory contexts. They draw on category knowledge, emotional

cues, and physical actions to organise new information. This suggests that hands-on learning works not just because it is active, but because it blends sensory, emotional, social, and cognitive elements in ways that make learning more meaningful and memorable.

4.1 Gap in the Literature

Even though hands-on learning is widely supported, there are still noticeable gaps in the research. Many studies examine short-term outcomes, and we know much less about how hands-on learning shapes long-term academic skills, especially in later childhood. There is also limited evidence from diverse cultural and socioeconomic contexts, making it difficult to claim that the findings apply broadly across different communities and educational systems.

Another gap lies in the connection between research and classroom practice. While developmental science provides strong insights into how sensory and motor systems support memory, these insights are not always translated into strategies that teachers can realistically use. Similarly, research on digital learning in early childhood tends to be scattered. Only a few studies look at how physical and digital learning can work together in a balanced way.

4.2 Future Research Directions

To strengthen the field and address existing gaps, future research should:

1. *Conduct longitudinal studies*

   Follow children over several years to identify the long-term effects of hands-on learning on academic performance and cognitive development.

2. *Expand research across cultures and contexts*

   Examine how hands-on learning works in different cultural, socio-economic, and linguistic settings.

3. *Investigate blended hands-on–digital learning models*

   Explore how physical manipulation and digital tools can complement each other without replacing real-world exploration.

4. *Study real-world implementation challenges*

Focus on teacher training, material availability, curriculum pressures, and classroom management to identify workable hands-on approaches.

5. Conclusion

The review highlights that hands-on learning is a central component of effective early childhood education. Across numerous studies, children demonstrate stronger understanding and more durable memory when they are able to touch, manipulate, move, and actively explore materials. Early learning is shown to be deeply embodied, with children relying on multi-sensory and emotionally meaningful experiences to process and retain new information. These findings emphasise that hands-on activities are not merely supplementary but are essential for supporting cognitive development, memory formation, and meaningful learning.

Hands-on, experiential activities contribute far beyond memory benefits. They enhance creativity, problem-solving abilities, confidence, social interaction, and intrinsic motivation. Learning environments that encourage exploration and physical engagement align closely with developmental needs in early childhood, allowing children to build knowledge in ways that feel natural and intuitive. While digital tools can support learning when used interactively, they function best when they complement rather than replace physical experiences.

Overall, the literature strongly supports the integration of tactile, exploratory, and multi-sensory activities within early childhood curricula. Such environments create richer learning opportunities and promote holistic development by aligning with how young children naturally learn—through doing, investigating, imagining, and interacting with the world around them.

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