

**SENSORY, MOTOR, AND COGNITIVE DEVELOPMENTAL SUPPORT BOXES FOR EARLY
CHILDHOOD**

By Kylie Palmer

A Senior Signature Honors Project Presented to the

Honors College

East Carolina University

In Partial Fulfillment of the

Requirements for

Graduation with Honors

By Kylie Palmer

Greenville, NC

June 11th, 2025

Approved by:

Dr. Lauren Turbeville

Mrs. Tricia Carter

Department of Occupational Therapy

Department of Communication Sciences and Disorders

Abstract:

This creative endeavor examines the effectiveness of customized sensory boxes that include 3D-printed elements and handmade toys designed to enhance sensory development for children, specifically at the Nancy W. Darden Development Center (NDCDC) in Greenville, North Carolina. The creative endeavor was achieved by Kylie Palmer (Communication Sciences and Disorders) and Ella Donahue (Psychology and Occupational Therapy). Tailored to developmental milestones seen from birth to early childhood, the sensory boxes integrate tactile, visual, and auditory activities designed to promote development. The boxes are organized into age-specific categories, but we encourage others to use the “milestones” categorized with typical age range before choosing the best fit. This includes, “The Little Explorer’s Box” (0-12 months), “The Little Learner’s Box” (12-24 months), “The Little Discoverer’s Box” (2-3 years), and “The Little Imaginator’s Box” (4-5 years). Each box is curated to foster development in all domains: sensory, motor, cognition, and language. Using the Revised Knox Play Scale, as well as information from undergraduate courses, we tailored each activity to relate to a typical developmental milestone. We also grouped items based on age-appropriate space management, material management, pretense-symbolic play, and participation. These sections were also used to conduct a survey for teachers after observing their students play with the sensory boxes.

When starting out at the Honors College, I never knew I would end up being able to work on a project that would genuinely help others. During Honors 2000 and Honors 3000, we were taught how to properly “pitch” an idea to others, a process that involves presenting a concept in a compelling and persuasive manner, take constructive criticism and honest feedback, and curate these comments into pivotal ideas for our projects. Just like our “Wicked Problems” from my freshman year, 2021, I realized that the issues we face today might not feasibly “disappear” or “go away” but could in the least be improved by those who have the resources to do so. Luckily, by attending East Carolina University’s Honors College, I was provided with many resources to do my part in making a change. I discovered my passion for speech pathology during my sophomore year, and did research into what fosters language development from birth until puberty (our language acquisition period), what makes language so much more innate during this time? How can we foster language in a natural play environment for children who are still in their language acquisition period and are delayed? An understanding of typical speech sound acquisition is paramount to understanding whether a child is actually delayed in their language, so I decided to begin learning more.

During my junior year at East Carolina, I decided to take an honors course with Mr. Wayne Godwin. His course was on finding creative ways to innovate. This course took me down the path of working with Mr. Godwin in the Innovation and Design Lab just off of ECU’s main campus. Here, I learned how to use 3-D printing machines, as well as sew, print posters, use a Cricut machine, and more! I took this course and worked on the job with a close friend from the honors college who later became my partner for our Signature Honors Project. With all these innovative products combined with a passion for change in facilitating healthy environments to enhance a child’s development, we were inspired to work on some prototypes of products that could engage children and benefit their development at the same time. To begin this, we had to have a solid understanding of what “typical development” looks like for children. Our mission was clear, and we were determined to make a difference.

We made the decision to keep a consistent record of what our data on “typical development” looks like. While every child develops differently and at different rates, it is important to have an “average” to know whether a child may need additional support. We used the Revised Knox Preschool Play Scale (L. Diane Parham, Linda S. Fazio) to support our data and give others a way to gauge the needs of a particular child. The data we collected was not just numbers but a powerful tool that could

guide us in our mission to enhance child development. Some important developmental milestones to keep in mind are Space Management, the way that children learn to manage their bodies and the space around them. Material Management, how children handle objects, manipulate materials, and explore different textures. Pretense-symbolic play, which is developing the ability to differentiate reality from make-believe through imagination and imitation. Lastly, participation, which is the amount and manner of interaction with their environment and peers. These “typical” results change between every six months of age.

Within these four main groups, some subgroups target specific aspects of a child’s development further. For example, in terms of space management, there are two subgroups: gross motor activity (play involving the whole body) and interest (attention to specific types of activities). For Material management, there are four subcategories: manipulation (fine motor control), construction (combining objects and making products), purpose (goals of activity), and attention (length of time in independent play). Referring to pretense-symbolic play, there are two subgroups: imitation (mirroring aspects of a cultural environment) and dramatization (pretend, the introduction of novelty, and role play). For participation, there are four subgroups, including type (level of social interaction in play), cooperation (ability to get along with others during play), humor (understanding and expression of humorous or incongruous words or events), and language (communication with others during play). These subcategories enabled us to break down age-appropriate play and explore how we can utilize play to foster positive developmental patterns in children further.



Figure above from left to right: The Little Explorer’s Handbook (0-12 months), The Little Learner’s Handbook (12-24 months), The Little Discoverer’s Handbook (2-3 years), and the Little Imaginator’s Handbook (4-5 years).

Typical Development from Birth to 12 Months

For this project, understanding the typical development of a child is paramount to fostering an experience where development is at the forefront of playtime.

Language and Social Skill Development: For an infant, we may hear reflexive vocalizations, which are automatic and controlled by the physical state of the infant. However, there are also non-reflexive vocalizations where infants coo and babble or playfully scream. At this level, an infant is prepared to begin understanding the concept of “turn-taking” for communicative purposes. An infant as early as 0-3 months can detect and react to familiar objects and sounds. During this period, infants can detect and favor familiar voices, make cooing sounds, and obtain a “social smile.” An infant will later develop canonical babbling, which consists of vocalizations that include adult-like sounds and may have some intent. Beginning from 5-10 months, this includes normal phonation and repetitive patterns and may include reduplicated consonant/vowel (CV) syllables such as “baba.” From 6-12 months, an infant will gesture intentions to communicate, respond to familiar words and facial expressions, and respond (with or without words) to questions (a rising intonation). Within 7-9 months, an infant will typically begin to imitate sounds, recognize words, and use social gestures. From 10-12 months, a typically developing child will begin to understand simple commands, use one or more words, and recognize their name.

Space Management: In the 0–6-month stage, an infant should demonstrate gross motor skills such as swiping, reaching, playing with hands and feet, and moving to continue pleasant sensations. Their interest should also include gazing at faces and following movements with their gaze, indicating their developing visual and cognitive skills. They should attend to voices and sounds and may explore objects within their reach. By the 6–12-month stage, infants should have the gross motor ability to reach, crawl, sit with balance, play with a toy while sitting, pull up to stand, and cruise. They should also show interest in following objects as they disappear, anticipating movements, and demonstrating goal-directed movement.

Material Management: In terms of manipulation and fine motor movement, infants at this age will handle objects/toys, mouth toys, bang, hit, pull, turn, poke, tear, drop, and pick up small objects. Between 0 and 6 months, their construction skills will be limited to putting two objects together. After 6

months, they may be able to combine related objects and put objects into containers. The purpose in younger infants may be to experience a sensation of some sort, while for infants aged 6-12 months, the purpose may be to understand cause-and-effect relationships or means-end relationships. This means that infants are searching for an understanding of what specific actions lead to specific or desired outcomes. In terms of attention, from 0 to 6 months, they will follow moving objects with their eyes, a key aspect of their attention and visual development, with attention lasting from 3 to 5 seconds. From 6-12 months, we will see about 15 seconds of attention for a detailed object and 30 seconds for a visually or audibly stimulating toy.

Pretense-Symbolic: Anywhere from 0-12 months, imitation is based on observed facial expressions, some vocalizations, and typically will imitate observed emotions and actions. Dramatization at this age is quite limited.

Participation: For infants aged 0-6 months, the type of participation observed is solitary, meaning there is no effort to interact with other children, but rather a preference for being picked up and/or swung. By 6-12 months, there will be some infant-to-infant interaction, and the infant may respond differently to the voice of an adult versus the voice of another child. From 0 to 6 months, cooperation typically involves only the demand for personal attention and involves some simple give-and-take interactions with a caregiver. For 6-12 months, the infant may initiate games rather than follow and show and give objects to others. For their humor, infants will smile and laugh at the feeling of anticipation or recognizable games.

Typical Development from 12-24 Months

Language and Social Skills Development: From ages 12 to 24 months, the onset of speech is considered the integrative stage, beginning at around 18 months of age. Here, there is a coexistence of babbling and meaningful words with intention. Around 12 months of age, the first "true" words typically develop. These have consistent phonetic forms, like adult forms, produced in predictable contexts and have expected consequences. Some milestones seen during this age range are the ability to recognize and point to body parts when named, following simple two-step commands, enjoying songs and stories, using two-word phrases (i.e., "more cookie"), using many different consonant sounds at the beginning of words, and by 18 months, prefers real words over jargon, expresses needs through language, and enjoys favorite stories.

Space Management: Between 12 and 18 months, we witness a remarkable transformation in a toddler's physical abilities. They progress from standing unsupported to sitting down, bending, recovering balance, and then walking with a wide stance, all while throwing a ball. Their curiosity is piqued by exploring various movement patterns and small objects. By 18-24 months, a toddler can run, squat, climb, get on and off chairs, kick a ball, and ride a kiddy car. This rapid physical development is truly a marvel to behold, showcasing the incredible growth of a toddler in just a few months!

Material Management: From 12-18 months, manipulation and fine motor control consist of throwing, pushing, pulling, carrying, turning, opening, and shutting. Their construction skills include stacking, disassembling, and reassembling, as well as being able to relate two similar objects (e.g., a lid on a pot). Their purpose for material play is along the lines of trial-and-error learning, as well as relational play. During this period, a toddler will have rapid shifts in their focus and a very short attention span. As the toddler reaches the latter end of this age range, 18-24 months, there is a drastic change in their abilities. A toddler from 18 to 24 months will typically be able to use mechanical toys, string beads, and pull-apart pop heads. They can use tools for toys appropriately and stack toys on top of each other. Toddlers in this age range can show foresight before acting in imaginative play and will be able to play quietly with a single object for 5 to 10 minutes.

Pretense-Symbolic: From 12-18 months, children will imitate simple actions and movements and engage in early pretend play. For toddlers aged 18-24 months, they will begin to develop deferred imitation and more complex role-playing skills. Children in this period will combine multiple pretend actions and use imaginary objects to create a more complex narrative.

Participation: Between 12 and 18 months, a toddler's social play is a mix of solitary and onlooker play, with some brief peer interactions. They may offer toys but are possessive over them, a typical behavior at this stage. They find incongruous events amusing and use gestures, and some words to communicate wants, as well as label some objects and respond to requests made by others. However, it is between 18 and 24 months that we see a significant leap in their social development. They mostly participate in onlooker play, with simple cooperative responses, and engage in more complex social play, enjoying mismatched labels or forms of playful teasing. Their expanding vocabulary, ability to ask simple questions, and reference to people or objects who are not currently present (object permanence begins to form) are all signs of their growing social skills, a delightful aspect of their development.

Typical Development from 2 Through 3 Years of Age

Language and Social Skills Development: The development from two years old through three years old is a crucial period. Neuroplasticity is moving at an extremely fast pace, and language input is crucial. By 24-30 months of age, a child will use more words than jargon and will be able to communicate ideas and observations. By the 30–36-month marker, the child typically will be able to frequently ask the “who, what, when, where, and why?” questions. Vowels are mastered earlier than consonants, with a typical 3-year-old being able to correctly produce almost all vowels and diphthongs, with mid-central vowels being an exception as they may not be mastered until 6 or 7 years of age. Around this milestone of 2-3 years, typical communicative developmental milestones consist of the ability to understand opposites (i.e., up/down), follow two-step directions, distinguish “mine” vs. “your,” match objects to actions (e.g., “which one do you eat?” looking at a graphic of an apple and a slide). A child around this developmental age will also be able to answer simple “who, what, and where?” questions, as well as understand common prepositions used in daily contexts (i.e., in, on, under). During this period, a child will typically begin to ask “why” and “yes/no” questions, use past tense verbs, and engage in eye contact. The child will also prefer to play with others rather than independently and engage in imaginative play rather than only stacking or throwing toys.

Space Management: By the age of 24-30 months, a child should be able to jump, stand on one foot, and throw a ball without falling, all while having a blast. They will also find interest in exploring new movement patterns and enjoy making messes, bringing a sense of fun and amusement to their development. By age 3, a child will typically be able to run around obstacles, climb objects, catch a ball, and stand on their tippy toes, all while maintaining their playful spirit. A child during this period will maintain interest in any rough-and-tumble play, adding an element of joy to their physical development.

Material Management: 3-year-olds fine motor skills will likely consist of the ability to feel, pat, squeeze, fill objects, and match and compare items. By 30 months, a child will be able to scribble, string beads, and solve small puzzles. During this period, their main purpose in play is to focus on the process of construction and play rather than the final product. However, by 36 months, a child will typically be able to participate in multi-scheme combinations, which are play activities that involve using multiple objects or actions in a coordinated manner and prefers to attend to toys with moving parts. From 24-30 months, a child’s attention span lasts around 5-10 minutes of independent play, but by 30-36 months, a child can engage in 15-30 minutes of focused play.

Pretense-Symbolic: By 24-30 months, a child will begin to imitate adult routine behaviors (such as brushing hair) and some peer behaviors. They will begin to create their own story narratives with toys, dolls, and stuffed animals. By 30-36 months, a child will use toys as agents of more abstract play and will expand their storytelling sequences.

Participation: During this time, children will engage in parallel play, enjoying the presence of peers. They may also begin simple association play by interacting with peers. On the early side, children are typically possessive of toys and may resist sharing in any form. However, by age three, children begin to develop empathy and may start to have an understanding of the wants and needs of others. Children from two through three years of age will laugh at simple incongruities and will find humor in more complex scenarios than before.

Typical Development from 4-5 Years

Language and Social Skills Development: There is a notable difference between language and social skills at this level. Social skills will slowly expand this year, and language skills are booming. By 36-48 months of age, a child will typically be able to use descriptive vocabulary, sing songs, and adjust their intonation relative to the listener. By that four-year mark, a child will typically have expanded their vocabulary to upwards of 15,000 words used daily. By the time a child is 5 years old, they will use both correct and incorrect forms of words, interact with peers through verbal communication, ask persistent questions, communicate complex thoughts and ideas, and organize peer activities through language. They will also be able to recall past events, tell short stories, categorize items, count to five, and understand groups of up to three. Some receptive aspects of communication to look out for during this period consist of the child's ability to hear and respond when called from another room, answer "who, what, when, where, and why?" questions, talk about their activities and past experiences, listen to short stories and answer related questions, and understand most conversations at home and in school settings.

Space Management: By the four-year mark, a child should typically be able to walk smoothly, jump on one foot, climb stairs using alternating feet, accelerate speed, decelerate, hop, skip, catch, and throw with control. At this stage, they are highly interested in fine motor challenges and exploring new activities. By about five years old, a typically developing child would engage in active play, test their strength using different means, climb ladders, and navigate obstacles with ease. At this age, their interest is primarily in taking pride in their work, comparing their creations with those of their peers, and engaging in complex, imaginative play.

Material Management: Regarding material management during the 36-48-month stage, a typically developed child should be able to hammer, sort, cut with kid scissors, and manipulate small objects. Their construction will consist of creating simple three-dimensional products with evident designs (i.e., using blocks, Legos, etc.). During this stage, the primary purpose of their construction is typically focused on completing a single project. They will engage with single toys or themes for around 10 minutes. By the time a typically developing child is five years old, they should have developed the fine motor skills to dress independently, use a knife to spread, disassemble toys, copy simple letters, and exhibit overall increased fine motor control with precise movements. A child at this age will construct complex structures with toys and can solve a 10-piece puzzle. Their purpose in construction and play is to prioritize self-expression and storytelling within their creations, focusing on a single theme for up to 15 minutes, as well as playing independently for around one hour.

Pretense-Symbolic: Around 4 years old, a child will typically begin to mimic real-world actions and routines in symbolic play, as well as develop pretend play scripts in advance while acting out emotions and stories. By 5 years old, pretense-symbolic play consists of an expanded play script that includes imaginative and abstract scenarios. They will also use a majority of familiar experiences with meaningful interactions to construct narratives for role-play with peers.

Participation: From 36-48 months, a child will engage in associative play, showing interest in peers over activities. They will begin turn-taking but may struggle with controlling or possessive impulses. At this stage, they will laugh at nonsense words and rhymes. By 48-60 months, a child will begin to participate in fully cooperative play, where small groups of peers organize to achieve shared goals. At this stage, a child will attempt to demonstrate leadership, take turns willingly, and enjoy the concept of teamwork, often struggling with “who is the boss.” By 5 years old, a child will typically find humor in exaggerations and distortions of familiar situations.

Why Play is Essential

Much evidence is presented today as to why play is highly relevant and crucial to a child's development. Object play, which involves any form of play that incorporates an object, is crucial for developing spatial awareness and has led scientists to research object play in order to understand the "interaction of humans with their physical environment" (Parham, Fazio, p. 219). The research conducted by Henderson (1992) suggests that it is through object play that an early foundation is laid for consistent interactions with objects and physical spaces in the adult world. Therefore, object play lays

the foundation for spatial awareness and the ability to control our bodies with consideration of the world around us.

Another strong source of evidence that play is crucial for development is Piaget's Play Theory, which emphasizes the development of cognition through play experience (Piaget 1952, 1962). Piaget viewed children as those who construct their understanding of the world through meaningful interaction and exploration. His theory outlines four stages of play and explains how they contribute to a child's development. The first phase is called the "sensorimotor stage" or a form of "practice play" ranging from birth to 2 years of age. This type of play involves repetitive motor actions and exploring the world through senses and movements. For example, babies shake rattles, bang objects, splash water, and repeat actions for pleasure. Here, children are developing object permanence (the understanding that objects continue to exist, even when not seen), self-recognition, and coordinating sensory and motor experiences. Towards the end of this stage, rudimentary symbolic play may emerge, and an understanding of means-end begins to develop. The second stage of Piaget's Play Theory is called the "preoperational stage," which spans the age range of 2 to 7 years old. This is a more symbolic play, and children begin to use objects and actions to represent other things (e.g., a block as a cell phone or a blanket as a superhero cape). Role-playing, imaginary friends, and dramatic play are prominent, as well as constructive play, which involves manipulating objects and creating products of their own. The preoperational stage helps to develop semiotic function, which is crucial for language development. Semiotic function is developing the ability to think of something symbolically. This stage is also often characterized by difficulty seeing things from others' perspectives, also known as egocentrism. Symbolic play helps children begin to explore different viewpoints. In contrast, constructive play fosters imagination and problem-solving skills, promoting cognitive development and making individuals more informed and knowledgeable about the world around them.

Our project spans up to five years, so while the information in the third and fourth stages is not directly relevant to our project, the research is still efficient in gaining an understanding of continued growth and development goals. The third stage introduced by Piaget is the "concrete operational stage," which typically occurs between the ages of 7 and 11 years old. This stage is marked by children developing a more logical and organized thought process; therefore, they play games with established rules. Lastly, the fourth stage, the "formal operational stage," applies to individuals 11 years and older,

where children continue to engage in games with rules, increasing in complexity, strategy, and hypothetical reasoning.

Children need play to develop schemas, which are mental frameworks used to interpret and respond to situations. These are often thought of as fundamental building blocks of knowledge that we gain through meaningful experiences. Schemas are like mental maps that children create based on their experiences and interactions with the environment. They are always being modified, refined, and reorganized as we learn through a process of adaptation.

This process of schema adaptation involves two complementary processes. The first is assimilation, which occurs when we integrate new information or experiences into our existing schemas. For example, if a child's schema for "dog" is four legs, furry, and barks, when they see a cat for the first time, they might point and say "doggie!" because the cat shares features that fit their existing "dog" schema. This is active during play when a child uses something symbolically, such as a banana or a cell phone. The second complementary process in adapting our schemas is accommodation, which occurs when new information does not fit into an existing schema; therefore, we must modify or create new schemas to incorporate the new information. This presents itself in play when a child tries to fit a square block into a round hole, and it does not work. Then, they accommodate by realizing that the shape of the block matters relative to the hole size, and they will adjust their action or schema for fitting objects into holes.

A child is far more motivated to play than to learn. However, when play is fostered through interest and child-led schemas, this leads to intrinsic motivation from the child, and learning falls naturally into place. "Play is the child's most natural activity, and research has shown that play encourages cognitive or thinking skills, social-emotional development, communication and language abilities, and movement proficiency." (Linder, *Transdisciplinary Play-based Intervention*, pg. 26). By making play materials that are self-motivating to promote exploration and child-directed play, children will begin to develop schemas and other forms of play that naturally encourage their learning and understanding of the world around them. Therefore, increasing their development. Capitalizing on what is already motivating to a child will ensure attention, exploration, and problem-solving and encourage the child to question the world around them and conceptualize it at a higher level.

Included in Sensory Boxes

For our first sensory box, we named it “The Little Explorer’s Box and Handbook.” The Little Explorer’s Box is designed for infants aged 0-12 months or those who are developmentally on track with these milestones, providing sensory and motor skill development opportunities through interactive play. It includes toys that help to foster early cognitive growth, coordination, and social engagement. The toys included in this box consist of 3D-printed shape sorting boards, 3D-printed rainbow stacking toys, homemade discovery bottles/shakers, a homemade ABC and 123 block string, homemade ABC dice, playdough, and some small, soft character toys.

Our 3D-printed shape sorting board adheres to the visual and auditory senses. This toy helps infants develop problem-solving skills by recognizing different shapes and matching them to corresponding slots. The activity enhances visual perception and fine motor skills while reinforcing early cognitive associations. The sound of dropping pieces into the slots provides additional auditory feedback, reinforcing their understanding of cause and effect. Here, we recommend that caretakers encourage the child to pick up and feel each shape and help guide their hand to place the shape into the correct slot. We also encourage caretakers to say shape names and colors out loud to reinforce learning.



Our 3D-printed rainbow stacking toy targets the visual and tactile senses. This toy is excellent for developing hand-eye coordination and spatial awareness. The vibrant colors and curved shapes engage infants visually, while stacking, knocking over, and constructing different shapes enhance problem-solving and creativity, as well as fostering an early sense of object permanence when smaller pieces are hidden under larger pieces. For the rainbow stacking toy, we encourage caretakers to stack the rings in front of the child and then remove them one by one to encourage their grasp. We also emphasize narrating color names and different themes as you go.

For our homemade discovery bottles/shakers, these bottles stimulate both auditory and visual senses. Infants are encouraged to shake, roll, and track moving objects inside the bottles, helping them develop sound localization skills and hand-eye coordination. The addition of beads, glitter, and small items provides engaging visual stimulation. We recommend that caretakers shake the discover bottles in

different locations around the room while the infant watches. This will encourage infants to utilize their sound localization skills and further enhance their language development in the long run. Localization is crucial for auditory and speech awareness; therefore, the more practice an infant has with localizing sound, the more they will audibly pick up in day-to-day contexts.

Our homemade ABC, 123-string toy introduces infants to letters in a hands-on way. Pointing to letters while singing or speaking, manipulating the string, and allowing infants to explore each side of the blocks promotes fine motor skills, joint attention, and early literacy development. Our recommendation for caregivers when using the string or the dice is to hold the string and move it back and forth to capture an infant's attention and see how long you can hold their attention. Then, sing the ABCs while pointing to the correlated letters, helping the infant begin to associate sounds with symbols. Finally, both our soft character toys and our playdough adhere to tactile senses. The toys provide comfort while promoting tactile exploration. Their soft, sleek texture strengthens an infant's grasp and fine motor skills. Different durability levels ensure that infants experience a range of sensory inputs while interacting with the toys through activities such as squeezing, holding, and cuddling. Here, we recommend using these squishy toys for a game of gentle tickling or peek-a-boo to encourage sensory exploration, turn-taking, and social interaction.

Overall, for The Little Explorer's Box (0-12 months), we advise that play includes exaggerated speech and facial expressions, encouragement of joint attention by holding toys at eye level, offering a variety of sensory experiences to promote overall development, and to narrate actions and activities to support language acquisition later on.

The Little Learner's Box and Handbook was designed for toddlers developmentally aged 12-24 months, focusing on early language acquisition, fine motor development, and problem-solving skills. The toys included in this box promote interactive learning and independent exploration. The toys consist of homemade nature and circus-themed magnet boards, Playdough, soft character toys, a 3D-printed bell, and a 3D-printed pizza puzzle.

Our homemade nature and circus-themed magnet boards provide a whimsical backdrop for storytelling and



imaginative exploration. Featuring colorful paper leaves and circus magnets, children can move the pieces around to create their own adventures. This simple, yet engaging activity fosters creativity, dramatization, social interaction, and narrative thinking, encouraging toddlers to build their own stories while strengthening their fine motor coordination.

The Elmo and Cookie Monster themed Playdough provides a fun and engaging way to build hand strength and dexterity. Toddlers can squish, roll, and shape the dough, promoting creativity while enhancing sensory and fine motor development. We recommend that caretakers create simple shapes or press their fingers into the dough, encouraging the toddler to do so, to explore new textures. For soft character toys, these provide comfort, tactile stimulation, and a sense of security. We recommend that caretakers use the plush toys for a game of pretend feeding or cuddling to encourage a sense of social-emotional development.

The 3D-printed bell that we made introduces toddlers to sound exploration and rhythm. Shaking the bell will help improve grasping and grip skills while encouraging an understanding of means-end. The sound from the bell also stimulates auditory processing and can be used to foster sound localization in toddlers. We encourage caretakers to shake the bell in different locations and rhythms to encourage the toddler to imitate, reinforcing auditory processing and sound localization.

Lastly, our 3D-printed pizza puzzle introduces toddlers to problem-solving and spatial awareness. The real-life application of the pizza puzzle is huge for little ones—recognizing objects that they see in their daily environment. As they match the pieces to form a full pizza, they refine their fine motor skills while pretend play is at the forefront of “pizza making”. We recommend naming the objects that belong on the pizza as you go to encourage their language development.

For our sensory box for 12-24 months, we encourage consumers to use repetition and simple, clear instructions to promote the use of these toys and reinforce a toddler’s learning. We also recommend encouraging parallel play and cooperative interactions, as well as providing a mix of structured play and free-play activities to support curiosity, independence, and problem solving. It is also important at this age to continuously model play interactions and encourage the toddler to imitate.



The Little Discoverer's Box and Handbook is designed for children aged 2 through 3 years, fostering early language acquisition, problem-solving skills, imaginative play, and social interaction. The toys encourage cognitive growth, emotional expression, and fine motor skill development. The toys included in this box include homemade felt life application boards for buttoning and counting, 3D-printed toy cellphone, 3D-printed dog puzzle, emotional dolls with facial expressions and felt clothing (happy, sad, angry), squishy Minnie and Mickey Mouse

toys, and an articulated snake toy.

Our handmade felt life application boards included in this box are our flower/button board, which provides a hands-on opportunity to practice essential fine motor skills, such as buttoning. The counting felt board allows children to tactically gain an understanding of how numbers build off each other. Both boards will engage in their fine motor skills, as well as their problem-solving and cognitive understanding of numbers. The buttons will allow children to build a sense of independence in self-care tasks.

The 3D-printed toy cell phone encourages early conversations and social role-playing. Children can have fun while practicing turn-taking during conversations, reinforce vocabulary, engage in imaginative storytelling, and other communicative tasks. A great way for caregivers to use this toy is to pretend to make a call to the child and take turns asking and answering questions to build the child's conversational skills.

Our 3D-printed dog puzzle helps children develop spatial reasoning, meaning, where shapes and objects "belong" relative to the space provided, as well as their problem-solving abilities. Matching these puzzle pieces will strengthen their fine motor skills and naming the different dog parts (i.e. ears, nose, tongue, mouth, cheek), will build their vocabulary and cognitive categorization skills.

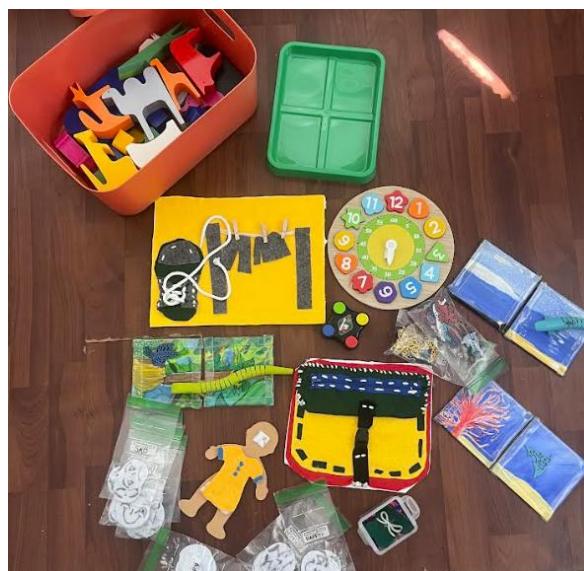
The homemade emotion dolls adhere to tactile, emotional recognition, and fine motor skills. The dolls in our Little Discoverer's set include the emotions "happy, sad, and angry". The Velcro introduces a new sensory item for children. These dolls help children recognize and properly express emotions by displaying different facial expressions. The added felt clothing allows them to be creative and create

their own narrative for the dolls. Engaging in pretend play, with the freedom of different emotional expressions, supports emotional; intelligence, peer to peer communication, and creativity. We recommend allowing the children to dress the dolls in different outfits and emotions, and to act out various social situations. This could be a daily routine, or a completely made-up scenario. Imagination is key here. This allows children to explore their emotions and relate them to experiences.

The squishy character toys also offer another source of tactile input. They are soft, sleek, and squishy, offering sensory input and stress relief. Playing with these toys will strengthen motor skills while providing comfort and tactile exploration. We recommend using squishy toys in a calm setting or calming activity, encouraging the child to squeeze and release them slowly and to take deep breaths. With stress-relief and tactile input in mind, we also handmade an articulated snake toy for this box. This allows children to explore the different movements of an animal, while giving them an idea of what is occurring in the natural world.

Overall, we recommend that for this developmental age range, the caretaker uses these toys to encourage pretend play to foster the child's problem-solving and social skills. We also encourage them to reinforce language development by modeling full sentences, support cooperative play by helping them navigate peer interactions, and to provide opportunities for independent decision-making during play.

The Little Imaginator's Box and Handbook are designed for children developmentally aged 4-5 years, fostering an understanding of the world around them, their creativity, problem-solving skills, emotional regulation, and cooperative play. The toys in this box promote advanced fine motor skills, language development, and emotional expression. The toys included in this box are emotion dolls with facial expressions and felt clothing (happy, sad, angry, silly, worried), analogue clock match board, large 3D-printed animal puzzle, felt life application boards for shoe tying, clipping, zippers, buckling, and velcroing, as well as a mini memory flash game and our homemade biome puzzle/play boards.



Our handmade dolls with facial expressions, including happy, sad, angry, worried, and silly, along with the felt clothing will promote creativity and emotional recognition. These dolls help children explore emotions to a deeper level while navigating different social situations. The dolls allow children to begin identifying more complex expressions and emotions, while felt clothes allow for more creativity and role-play. We recommend using the dolls to initiate discussions of emotions and to encourage role-playing different situations, as well as asking questions to the child such as, “how might your doll feel about that?”.

The analogue clock matching board helps children of this age develop early math skills through counting and matching numbers to clock positions. It enhances number sequencing and problem-solving skills while reinforcing concepts of time. The miniature memory flash game is attention grabbing with its flashing lights, and strengthens memory, attention span, and cognitive flexibility by challenging children to match and recall visual patterns, supporting early learning skills.

The large 3D-printed animal puzzle promotes cognitive functioning and fine motor development as children identify and fit animal pieces together. This encourages problem solving and categorization skills. Here, we encourage caretakers to take advantage of the colorful and large print. We would encourage problem-solving by matching animal pieces, discussing animal characteristics, naming animals, and naming colors.

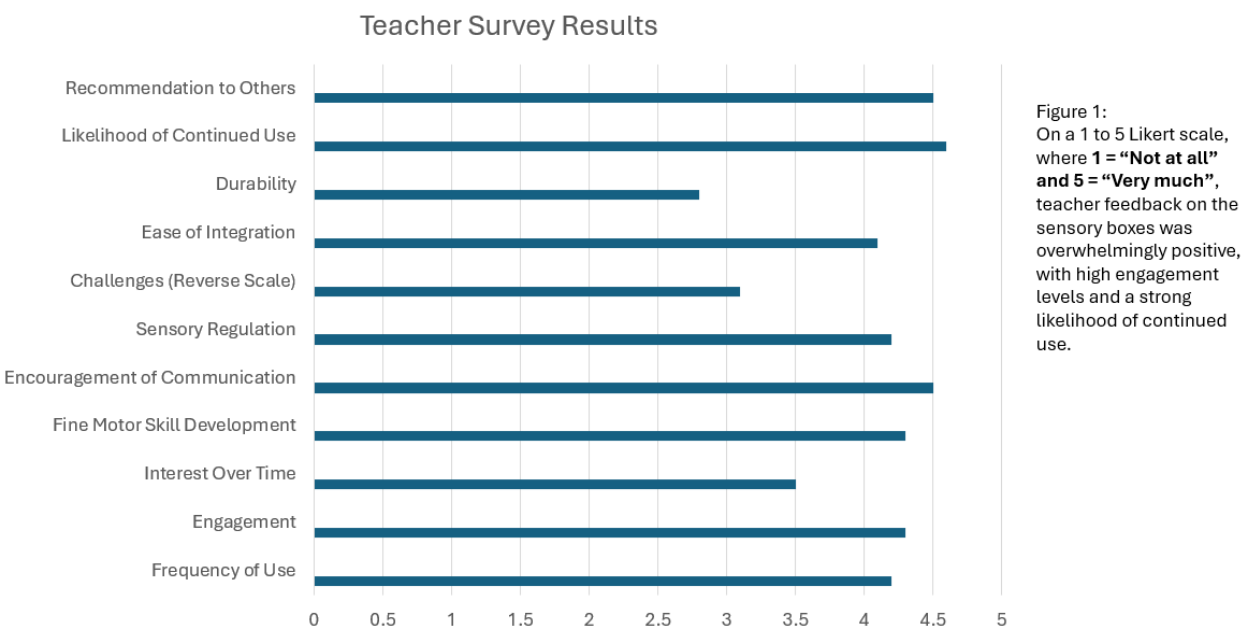
Our real life felt application boards provide hands-on opportunities to practice essential dressing skills such as zipping, clipping, buttoning, and tying shoes. By engaging with different fasteners, children enhance their fine motor skills and hand strength while building a sense of independence in self-care tasks and essential everyday skills.

The homemade biome puzzle boards are hand-painted to represent different biomes seen in the natural world. It features different environments such as forests and oceans, and children can move the characters around to create their own adventures. We included articulated sea animals, forest animals, and arctic animals to allow children freedom to explore different areas of the world. These boards provide an open-ended storytelling experience, fostering creativity, language development, and social skills. Overall, for this age range, we recommend providing opportunities for cooperative problem-solving and group play. We also recommend encouraging self-expression through pretend play and storytelling, to use open-ended questions to promote deeper thinking, reasoning, and language development, and to foster the child’s independence through structured and flexible activities.

Performance and Results

All the above information is explained in our user-friendly handbooks, designed to be easily understood by anyone, regardless of their background in childhood development. These handbooks are a valuable resource, providing an introduction, a list of each toy included, its descriptions and sensory classification, typical developmental milestones, age-specific play development, toy-specific play ideas, and tips for consumers.

Our testing process is comprehensive. We observed children in specific age groups playing with our toys, then left the toys with them for a week before returning to observe again. We collected data during our presence, and when we were not there, we asked teachers to document the children's use of the toys, their reactions, and the learning outcomes.



To obtain numerical results, we surveyed the teachers who observed the children's play. Our survey consisted of eleven sections that constitute our goals for our sensory boxes. Our recommendations to others and the likelihood of continued use categories average around 4.5/5, suggesting high support for integrating the sensory boxes into classroom environments. The durability received the lowest rating, at about 2.7/5. This was not surprising, as many of the toys are homemade, and the available resources did not allow for extremely durable products. The teachers suggested improvements in making the materials more sturdy, secure, and long-lasting. Ease of integration

received a score of 4.2/5, indicating that teachers found it relatively simple to incorporate the boxes into their classroom routines. Challenges, on a reverse scale, received a rating of 3.2/5. This data indicates that some difficulties were encountered during the play, and after speaking with the teachers, their main concerns were, again, the durability of the products. However, the challenges are not too significant of barriers to continuing use of the toys. The sensory regulation category received a 4.2/5, indicating that the toys that adhere to sensory regulation were effective and used by the children. The fine motor skill development category also received a high score of 4.3/5, highlighting the effectiveness of our products in enhancing overall developmental skills during play. For the encouraging communication category, teachers scored this at 4.5/5, indicating that the provided toys offer conversational topics and new games and foster peer interaction among the children, thereby increasing their curiosity. The 'child interest over time' category received a lower score of 3.5/5, indicating that while the products were used and well-received by the children, they are still actively showing a higher attention span toward toys that can move or light up. Child engagement received a high score of 4.3/5, while the frequency of child use received a score of 4.1/5, reinforcing that the boxes were actively used, effective, and enjoyable for the children.

In conclusion, our comprehensive assessment of the sensory boxes highlights their significant impact on children's development and engagement in classroom environments. The positive feedback from teachers, particularly in areas such as communication, fine motor skills, and sensory regulation, underscores the effectiveness of play in fostering essential developmental milestones. While some durability concerns were raised, the overall support for integrating these sensory boxes into daily routines remains strong. The high scores in child engagement and frequency of use indicate that these toys not only capture children's interest but also promote active learning and peer interaction. Moving forward, we will take the teachers' valuable suggestions into account to enhance the durability of our products while maintaining their educational value. With continued observation and updates based on feedback, we are committed to providing resources that support childhood development and enrich the learning experience.

References

- Bhatnagar, Subhash Chandra (2018). *Neuroscience for the study of communicative disorders* (fifth ed.). Philadelphia, PA: Wolters Kluwer.
- Case-Smith, O'Brien (2010). *Occupational therapy for children* (sixth ed.). Maryland Heights, MO: Mosby Elsevier Rights Dept.
- Gibbs, Varleisha D. (2021). *Sensorimotor interventions to improve social, emotional, and cognitive functioning: Neurological approaches for children and adolescents with autism*. Eau Claire, WI: PESI Inc.
- Linder, T.W. (1993). *Transdisciplinary play-based assessment: A functional approach to working with young children* (rev. ed.). Baltimore: Paul H. Brookes Publishing Co.
- Linder, T.W. (1997) *Transdisciplinary play-based intervention: guidelines for developing a meaningful curriculum for young children*. Baltimore, MD: Paul H. Brookes Publishing Co.
- Malik, F. (2023, April 23). *Cognitive development*. StatPearls [Internet].
<https://www.ncbi.nlm.nih.gov/books/NBK537095/>
- McLeod, S., on, U., & 4, J. (2025, June 4). *Piaget's theory and stages of cognitive development*. Simply Psychology. <https://www.simplypsychology.org/piaget.html>
- N/A: *The impact of Object Play*. Children's Museum of Atlanta. (2020, May 14).
<https://childrensmuseumatlanta.org/impact-of-object-play/>
- Parham, L.D. and Fazio, Linda S. (2008). *Play in occupational therapy for children* (second ed.). St. Louis, MO: Mosby Elsevier Rights Dept.

Acknowledgements:

Dr. Lauren Turbeville, Dr. James Ellis, Mrs. Tricia Carter, Mr. Wayne Godwin, Nancy W. Darden Childhood Development Center, Isley Innovation Hub, Innovation Design Lab, Revised Knox Play Scale for Occupational Therapy.