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Enhancing Executive Functions in Early Childhood: Scientific Approaches to Teaching and Parenting

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Abstract: ***Enhancing Executive Functions in Early Childhood: Scientific Approaches to Teaching and Parenting. This article explores the intersection of scientific methodologies and early childhood education, emphasizing the role of guided and open-ended inquiry in fostering executive function and academic achievement. Drawing on recent scholarly perspectives, it redefines scientific investigation as a flexible, context-sensitive process rather than a rigid sequence of steps. The discussion highlights the Froebelian model and Bayesian thinking in children, illustrating how natural learning diverges from traditional scientific methods. Key pedagogical strategies such as storytelling and cooking are analyzed as vehicles for inquiry-based learning, activating cognitive, social, and motor skills crucial for development. The article distinguishes between guided and open-ended inquiry, outlining their respective impacts on critical thinking, creativity, and self-regulation. By linking executive function to lifelong learning and academic success, the article provides actionable recommendations for educators and parents to cultivate challenging yet supportive environments. Ultimately, it advocates for a holistic approach that balances structured guidance with autonomy, preparing children to thrive as motivated, resilient, and confident learners.***

Keywords: Executive Function, Early Childhood Education, Guided Inquiry, Scientific Methodology, Holistic Development

1. Introduction

We often wonder how to understand a child's brain without invasive methods such as Electroencephalogram (EEG) or brain imaging. These tools reveal activity in areas such as the hypothalamus or amygdala. We must rely on other approaches to observe what is happening inside based on the stimulus received by the brain. Stimuli can be considered part of the methodology that shapes both the child’s future and the community in which they will live. Simply put, it’s about our approach to interacting with young children, sometimes straightforward, sometimes complex. It is how we approach things with our early years child’ or ‘how we do things with our early years child .

This article examines how scientific methodologies in early teaching and parenting enhance executive functions and support academic success. The main focus on key methodologies in this current article are guided inquiry, open-ended inquiry, and discovery learning in line with cognitive theory. This study is considered significant in redefining how inquiry-based learning fosters cognitive development, offering evidence-based approaches to integrate executive function training into early childhood practices.

2. Redefining the Scientific Investigation Method in Early Childhood: A Contemporary Perspective

The scientific investigation method has traditionally been characterized by a linear sequence of steps: observation, hypothesis formulation, experimentation, and conclusion. However, recent scholarship has challenged this rigid framework, proposing more nuanced and flexible definitions that reflect the complexity of modern scientific inquiry. It is now more appropriate to think along the lines of Krauss (2024) that argues that the classical model of the scientific method is insufficient to account for many landmark discoveries in science as some discoveries are made and then verified based on scientific laws. His analysis of historical breakthroughs revealed that approximately 25% of major scientific discoveries since 1900 did not adhere strictly to the traditional triad of observation, experimentation, and hypothesis testing. Instead, Krauss emphasizes the role of sophisticated instruments and methodologies such as particle accelerators and statistical modeling that extend human cognition and enable discovery beyond conventional empirical constraints. He proposes a broader definition of scientific investigation as a dynamic process driven by technological and conceptual innovation (Krauss, 2024). Complementing this view, Gamage (2025) explores the philosophical underpinnings of scientific inquiry, highlighting how epistemological stance influences methodological choices. Using the Research Onion Model, Gamage demonstrates that scientific investigation is not a one-size-fits-all procedure but rather a layered and strategic process. Researchers might need to align their philosophical orientation whether positivist, interpretivist, or pragmatic with appropriate methodological frameworks, including quantitative, qualitative, or mixed methods. This perspective reframes scientific investigation as a context-sensitive endeavor shaped by both theoretical and practical considerations (Gamage, 2025). In the realm of science education, Fukuda et al. (2022) advocate for a shift in how scientific inquiry is taught and assessed. Their systematic review underscores the importance of evaluating students’ ability to select appropriate methods, recognize limitations, and replicate findings. This approach moves beyond rote application of the scientific method and encourages deeper engagement with the epistemic foundations of inquiry. The authors argue that fostering these skills is essential for cultivating authentic scientific thinking in educational settings (Fukuda et al., 2022).

The table 1 below shows Contrast with the Scientific Method. While the scientific method is valuable for structured inquiry, young children often learn in ways that are nonlinear, spontaneous, and emotionally driven. Their learning is sparked by what happens around them, not by a pre-set question or hypothesis.

Table 1: Scientific Method vs. Child's Natural Learning

Feature	Scientific Method	Child's Natural Learning
Structure	Linear and procedural	Fluid and emergent
Initiation	Begins with hypothesis	Begins with experience
Control	Controlled variables	Dynamic, unpredictable
Tools	Instruments, data	Senses, play, relationships
Goal	Test and prove	Explore and understand

The Froebelian model emphasizes that children are autonomous learners who begin learning when something meaningful happens in their environment. This aligns with the concept of relevance in learning brought up by Abou Nasr Kassir (2025) and inquiry for motivation in Kassir (2019). Learning is holistic, interconnected, and rooted in real-life experiences, not compartmentalized steps (Adams & Short, 2024). Froebelian educators believe that children learn best by doing things for themselves, reflecting on their experiences, and engaging with nature and community. This approach values freedom with guidance, where play is central and learning emerges organically from the child's surroundings.

Alison Gopnik's research explains the difference between scientific thinking and natural learning and challenges the traditional view that preschoolers are irrational or pre-scientific. Instead, she shows that children's learning mechanisms resemble Bayesian inference, where they learn from probabilistic patterns in their environment rather than through formal hypothesis testing (Gopnik, 2012). This means children often learn opportunistically and intuitively, adapting to what they observe and experience rather than following a rigid scientific method.

The home learning environment (HLE) through parenting is a catalyst and plays a foundational role in shaping children's cognitive and emotional development. Learning begins well before formal schooling, through everyday interactions, routines, and play. Those routines start from the simplest actions such as approaching the mint leaves, garlic chops, and onions to be smelled by the child during your cooking practice, or discussing the project challenges and verbalising the risks and having them discussed with the young learner. According to Van Herwegen (2024), children's learning is deeply influenced by attention, engagement, feedback, and consolidation elements that arise naturally in responsive environments, not through structured experimentation. In sum, make the child a partner in your daily life without hesitation, using simple rather than jargon-heavy language.

To conclude, children are natural-born scientists. From the moment they begin to explore their environment, they ask questions, test ideas, and seek meaning. The scientific investigation in early childhood is less about formal experiments and more about playful exploration and meaning-making and relevance as in Abou Nasr Kassir (2025). Children use their senses and record observations and use tools to extend their senses of discovery of the world surrounding them and the existing theories and coaching is made by their parents, caregivers and teachers (Van Herwegen, 2024).

3. Defining Guided Inquiry: Contemporary Perspectives of A Reform

Guided inquiry has emerged as a central pedagogical approach within inquiry-based learning, particularly in science and information literacy education. Scholars from 2022 onward have refined its definition, emphasizing its structured yet student-centered nature and its role in fostering critical thinking and deep learning. Kassir (2019) emphasized its impact on motivation and improving students' academic achievement. Edwards (2022) defines Guided Inquiry Design (GID) as a research-based pedagogical framework that transforms schools into collaborative inquiry communities. Built upon the information search process, GID integrates inquiry seamlessly with curriculum standards and supports students from pre-kindergarten through grade 12. It provides a roadmap for inquiry-based learning that balances teacher guidance with student autonomy, enabling learners to explore topics within an information-rich context while developing research and reasoning skills (Edwards, 2022).

Istiana, Jatmiko, and Prahani (2023) emphasize guided inquiry as a method that significantly enhances students' critical thinking skills. The authors describe guided inquiry as a scaffolded process where students are given a goal and a structured path but retain control over their learning journey, promoting deeper engagement and intellectual independence (Istiana et al., 2023). Beagle Learning (2022) offers a practical definition, describing guided inquiry as a learning model where teachers provide the goal and process, but students take charge of the investigation. This approach sharpens students' critical thinking and problem-solving abilities by encouraging them to ask questions, explore resources, and construct knowledge actively. The model is particularly effective in STEM education and project-based learning environments (Beagle Learning, 2022). Together, these definitions reflect a shift toward viewing guided inquiry not merely as a teaching strategy but as a philosophy of learning; one that values curiosity, autonomy, and structured exploration. The emphasis on scaffolding, collaboration, and information literacy positions guided inquiry as a vital tool for 21st-century education.

Early childhood is a critical period for cognitive development, and children are naturally inclined to explore, question, and make sense of the world around them (Kassir, 2019). Inquiry-based learning particularly through guided and open-ended inquiry offers a powerful framework for nurturing scientific thinking from a young age. By integrating the scientific method into playful exploration, educators can foster curiosity, critical thinking, and lifelong learning dispositions. Guided inquiry involves teacher-supported exploration where children investigate a provided question using self-designed methods. This approach scaffolds learning while promoting autonomy and critical thinking (Beagle Learning, 2024). For example, children might explore "What do plants need to grow?" by designing their own planting experiments. Open-ended inquiry, by contrast, allows children to generate their own questions and methods, mirroring authentic scientific research. It demands higher-order thinking and fosters creativity, problem-solving, and sustained engagement (Talafian et al., 2025).

3.1 An example of a Story Telling in Guided Inquiry

Storytelling encourages reflection and documentation through questioning, discussions, observations, and listening skills that we define in the curriculum standards as the ability to understand the speaking and verbalizing that into a literature : text writing, drawing or scribbling or adding forms that are relevant to the child within his context based on the herd. After that, the child is able to express, explain and talk about his written trace and explain it in a very logical and systematic manner using his own words from his own vocabulary terms.

The figure 1 below shows a story telling sample that can develop some patterns of critical thinking skills & predictions. In Figure 1, when the first Figure 1.A is explained, the teacher orients the thinking into the child' s mind and will enhance the imagination to a probable ending in Figure 1.B that quite dictated by a starting point induced by the teacher:A good application of what we call a guided inquiry. The teacher guides in the beginning inducing hints of the story and leaves the rest to the child's imagination and prompts. However in this type of guided approach we cannot have a deep look into the child's mind and his reflective thinking or his concerns and challenges moreover his own perception of fear, of colors' meanings. Although this remains an analytical approach using samples of picturized stories, the guided inquiry served as a good starting point for novice teachers and parents to guide step by step the growth of the mindset.

Figure 1 (A)

Figure 1 (B)
Figure 1: *Guilloppé, Loup noir*, Booknode, 2017

3.2 Cooking in Guided inquiry

Cooking in early childhood serves as a powerful context for guided inquiry in science and the development of executive functions. When children engage in cooking, they naturally explore scientific concepts such as changes in states of matter, cause and effect, and measurement. This aligns with guided inquiry, which encourages children to ask questions, make predictions, and reflect on outcomes (Galuert, Heal & Cook, 2003). Cooking also activates key executive functions planning, working memory, cognitive flexibility, and inhibitory control. For example, following a recipe requires sequencing steps and remembering instructions, while adapting to unexpected changes (like missing ingredients) fosters flexibility and problem-solving (Summit Ranch, 2025). These skills are essential for self-regulation and academic readiness. Moreover, cooking offers a multisensory, inclusive learning experience that supports diverse learners. It integrates math, literacy, and motor development while promoting collaboration and language growth (Vasi, 2023). The balance of structure and autonomy in cooking activities mirrors effective inquiry-based learning, where guidance enhances knowledge but autonomy supports engagement and executive function development (Roll et al., 2018). The below table 2 chart illustrates how different child skills are activated and developed during various stages of cooking.

Table 2: Skills Working Simultaneously While Cooking

Skill Area	What Happens During Cooking
Executive Functions	Children plan steps, follow sequences, and regulate impulses.
Scientific Inquiry	They observe changes, make predictions, and test outcomes.
Motor Skills	Fine and gross motor coordination is engaged through stirring, pouring, etc.
Collaboration	Children communicate, take turns, and work together with peers or adults.

In addition to that, the below *Chart 1* shows how each skill varies in intensity from 1 to 10 across the four cooking stages: Preparation, Cooking, Serving, and Cleanup.

Preparation Stage the most common preparation in early years is to make a vegetable salad- includes washing and sorting the vegetables and measuring the ingredients and then mixing them and finally setting up utensils and bowls. The Skills Activated are many; in the executive functions we have planning, sequencing (Intensity: 8/10); Observing textures and colors is the scientific inquiry: (7/10); Gripping, slicing with child-safe tools (6/10) are the motor skills menu and finally sharing the tools and the kitchen space is collaboration and teamwork.

A classic example of the cooking stage is preparing pancakes. It includes the egg's cracking and whisking and then cooking on a supervised hot plate while observing changes in texture and color. The skills activated in the Executive Functions are mainly following steps and trying to avoid approaching the heat to avoid risks of burn (7/10). Other main skills really worked in the scientific inquiry of cooking is that a child could experience the first physical changes while watching heat transform ingredients into a new texture and a chemical change to have new outcomes appearing as a result of the separated ingredients (9/10). Cooking needs high motor skills of stirring, pouring (8/10). Finally, cooking raises trust because the child has to leave the teacher finalising the cooking while believing that by the end they will all share the final product; a true collaboration with his peers while taking turns and helping each other (7/10).

During the Serving Stage, children can participate in creating fruit skewers, arranging fruit pieces with care, decorating plates, and serving their creations to classmates. This process engages several key developmental skills. Executive functions such as classification and matching the similar patterns together developing higher order thinking, later organizing and presenting are fostered, rated at an intensity of 6 out of 10. Through this scientific inquiry, children compare shapes and sizes of fruit pieces and prepare geometry and trigonometry thinking (6/10), while their fine motor skills come into play as they precisely place each item (7/10). Collaboration is highly encouraged, as children share and offer food to one another, demonstrating teamwork at an intensity of 8 out of 10.

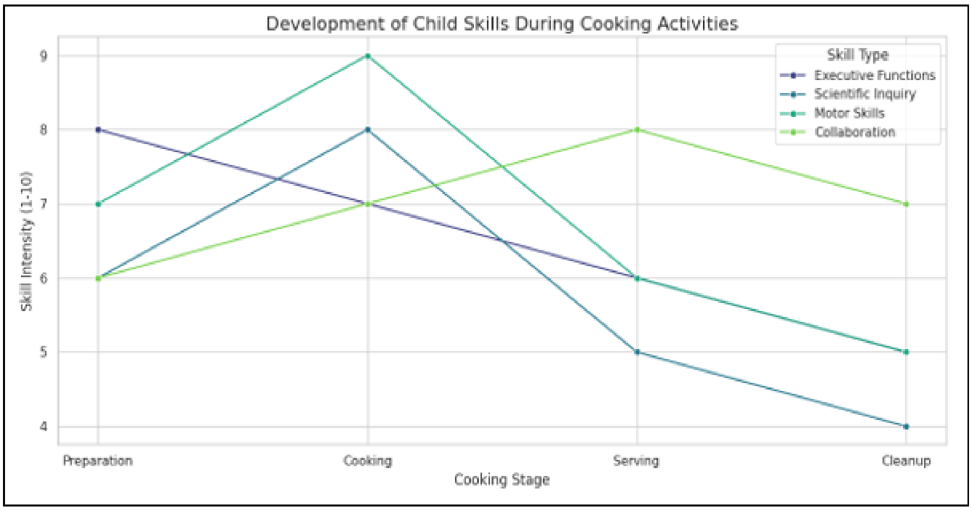

Chart 1: Development of Child Skills During Cooking Activities

Throughout the four stages of cooking: Preparation, Cooking, Serving, and Cleanup, children engage a spectrum of developmental skills. During preparation, tasks like washing, sorting, and measuring activate planning, sequencing, observation, fine motor coordination, and teamwork. Cooking strengthens these abilities further, particularly scientific inquiry and motor skills, as children observe transformations and practice stirring, pouring, and collaborating safely. Serving focuses on organizing, classifying, matching, and precise placement, honing higher-order thinking and social skills as children share and present food. Finally, cleanup nurtures responsibility and routine, categorization, motor tasks like scrubbing and drying, and reinforces collaborative turn-taking. It is where a student builds routines and social responsibility without waiting for anything in return. Together, these stages provide a holistic context on how guided inquiry is a powerful tool for the development of executive function, scientific inquiry, motor coordination, and collaborative abilities.

These skills are graded and scored as part of the national certification in the laboratory benchmarked test for national certificate of the international baccalaureate. Their practice as a routine impacts their achievements at a later stage.

4. Defining Open-Ended Inquiry: A Contemporary Perspective

A child asks, "Why do shadows change?" and explores the phenomenon through observation and discussion. Open-ended inquiry has gained prominence as a pedagogical approach that emphasizes student autonomy, authentic problem-solving, and the emulation of scientific practices. Unlike structured or guided inquiry, open-ended inquiry allows learners to define problems, formulate hypotheses, and design investigations with minimal prescriptive guidance. Talafian et al. (2025) describe open-ended inquiry as a reform-based instructional model that enables students to make experimental decisions and engage deeply with the scientific process. In their study of high school physics teachers, they found that open-ended inquiry fosters authentic science learning but is often hindered by institutional barriers, resource limitations, and teacher perceptions. The authors highlight the importance of supportive communities of practice (CoP) in helping educators transition from structured labs to open-ended formats (Talafian et al., 2025). Öztürk, Kaya, and Demir (2022) define open-ended inquiry within the broader framework of inquiry-based learning. They emphasize that this approach requires students to work like scientists posing questions, constructing hypotheses, and developing diverse methods for solving problems. Their meta-analysis shows that open-ended inquiry contributes significantly to the development of critical thinking, creativity, and scientific reasoning (Öztürk et al., 2022). Wang et al. (2023) focus on the role of questioning chains in open-ended inquiry. They argue that effective open-ended inquiry involves a sequence of logically connected questions that guide students toward conceptual understanding. Their study introduces an instrument for analyzing how pre-service teachers use open-ended questions to scaffold student thinking in science education (Wang et al., 2023). Together, these studies underscore that open-ended inquiry is not merely a teaching strategy but a philosophy of learning that prioritizes exploration, autonomy, and epistemic agency. It challenges traditional models by placing students at the center of the investigative process and encouraging them to construct knowledge through experience and reflection.

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Children acquire the capacity to hypothesize, test, and refine their conceptions through active engagement, thereby fostering critical thinking (Scholl, 2024). Inquiry-based learning frameworks can be differentiated along a spectrum: structured inquiry, where both the question and method are provided; guided inquiry, which presents the investigative question but enables children to devise their own methodologies; and open-ended inquiry, wherein learners independently generate both the research question and the investigative process (Scholl, 2024). These frameworks are congruent with the organic learning processes observed in early childhood, as young learners excel when afforded opportunities to pursue their own intellectual curiosities. Notably, inquiry-based learning, particularly guided and open-ended approaches, resonates with the developmental characteristics of early childhood. This pedagogical alignment leverages children's intrinsic motivation to investigate and interpret their surroundings (Van Herwegen, 2024). Environments rich in opportunities for inquiry support narrative construction, question posing, and explanatory dialogue, thereby cultivating linguistic development and epistemic growth (Edwards, 2022). Within such settings, children assume ownership of their learning, nurturing both independence and resilience, which are essential for academic self-efficacy. Furthermore, inquiry-based approaches by structuring learning as a dynamic interplay across cognitive, social, emotional, and physical domains facilitate holistic growth (Beagle Learning, 2022; Istiana et al., 2023). Thus, inquiry not only encourages confidence and agency for the child but also establishes a robust foundation for lifelong learning.the table 3 shows a quick summary and includes the role of the educator in the formula.

Table 3: Guided vs. Open-Ended Inquiry in Early Years

Type of Inquiry	Definition	Role of Educator	Role of Child	Example
Guided Inquiry	Teacher provides question; child designs method	Scaffold and support	Investigate and analyze	"What do plants need to grow?"
Open-Ended Inquiry	Child formulates question and method	Facilitate and provoke thinking	Lead entire process	"Why do shadows change?"

5. Linking Executive Function to Academic Success

Executive function refers to a set of cognitive skills including working memory, inhibitory control, and cognitive flexibility (Doebel, 2020). These skills begin developing shortly after birth, with ages 3 to 5 representing a critical window for growth. These cognitive abilities underpin as well children's capacity to focus attention, follow instructions, and complete tasks, each of which is critical to learning and scholastic success (Best, Miller, & Naglieri, 2011). Furthermore, EF enables children to follow multi-step instructions, EF skills are vital to children's educational attainment and broader life success by regulating their behaviors and emotions, planning and organize activities, manage distractions, and persist in problem-solving skills essential for inquiry-based learning (Center on the Developing Child, 2024).

As stated earlier, Science inquiry in early childhood is not merely about learning facts, it's about cultivating habits of mind: curiosity, persistence, and reasoning. These habits are deeply intertwined with executive function, which governs how children control impulses, shift attention, and hold information in mind (Center on the Developing Child, 2024). As children engage in scientific exploration, they draw on EF to plan investigations, adjust strategies, and reflect on outcomes. Doebel (2020) argues that EF should not be viewed as isolated cognitive components but as goal-directed control systems shaped by children's values, experiences, and motivations. This perspective aligns with inquiry-based learning, where children pursue meaningful questions and adapt their thinking in response to new information.

5.1 Science open ended Inquiry and EF in Practice

A longitudinal study by Vidal Carulla, Christodoulakis, and Adbo (2021) examined how preschool children's EF developed through play-based science activities. The intervention embedded chemistry and biology concepts into imaginative scenarios, such as royal characters and magical transformations. Results showed that cognitive flexibility, which is the ability to shift perspectives, was enhanced when children engaged in narrative-rich science tasks. Over time, children transferred these EF skills from fantasy contexts to real-world problem-solving. This finding supports the idea that inquiry-based science is not just content delivery it's a developmental tool for strengthening EF.

"Science activities can be a bridge for preschool children to transfer their use of executive functions, from fairytales and games toward everyday tasks" (Vidal Carulla et al., 2021, p. 2).

Executive function (EF) forms the cognitive backbone of early childhood learning, empowering children to focus, plan, and adapt within diverse educational settings (Diamond & Lee, 2011; Blair & Raver, 2015). Strategies that foster EF include responsive teaching, play-based learning, and structured programs such as "Tools of the Mind" and "Promoting Alternative Thinking Strategies"—all shown to improve planning, attention, and self-regulation. Incorporating mindfulness activities also helps children regulate their emotions and behaviors, while active learning and experiential activities promote critical thinking and flexible problem-solving (Center on the Developing Child at Harvard University, 2017).

6. Implications for Educators

Educators support EF by designing developmentally appropriate challenges, teaching self-monitoring and self-awareness, encouraging regular physical activity, and using games as engaging tools to reinforce skills. Beyond the classroom, parents can nurture EF by modeling self-control, providing routines that encourage planning, and engaging children in activities that require turn-taking, following instructions, or collaborative goal-setting at home. Involving families further strengthens EF growth, ensuring that these

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strategies are consistently supported across both educational and home environments. Collectively, these approaches empower children to approach inquiry, scientific methods, and everyday challenges with confidence, resilience, and creativity. Executive function and science inquiry are deeply interconnected in early childhood. Inquiry-based learning provides a rich context for developing EF skills, while strong EF enables children to engage more deeply in scientific exploration. By designing environments that nurture both, educators can support holistic cognitive development and empower children as thinkers and investigators. The story telling below that has been mentioned in the guided inquiry earlier can be used to stimulate higher order thinking and touch on more in depth skills related to the social emotional intelligence as well as the education psychology in early years. In consequence, as per the above Figure 2.C and Figure 2.D educators can foster EF and science inquiry simultaneously by: 1) Encouraging open-ended questions and investigations. 2) Using storytelling and imaginative play to scaffold cognitive flexibility. 3) Supporting reflection and metacognition through journaling or discussion. 4) Creating environments that allow for trial, error, and revision. These strategies align with developmental science and promote both scientific reasoning and executive control, preparing children for lifelong learning.

Figure 2 (C)
Guilloppé, Loup noir, Booknode, 2017

Figure 2 (D)
Guilloppé, Loup noir, Booknode, 2017

Figure 2: Story telling samples that can develop more patterns of education psychology and emotional intelligence and social emotional perspectives through an open ended inquiry based approach.

When Figure 2.C is presented without explanation, the teacher poses open-ended questions, allowing the child to develop scenarios and the child will connect Figure 2C to 2D. 1) items of the picture 2) identifying the character 3) their relationship 3) connection of the two and 4) intentions 5) what happened by the end. Furthermore, as mentioned earlier, cooking should be embraced not just as a life skill, but as a pedagogical tool by educators for the following reasons: 1) It fosters curiosity and scientific thinking. 2) It strengthens executive functions through real-world practice. 3) It supports inclusive learning by engaging diverse learners through multisensory experiences. Educators can scaffold cooking activities with open-ended questions, visual cues, and collaborative tasks to maximize their cognitive and developmental impact (Eti et al., 2021).

Guided inquiry and executive functions are deeply intertwined. Yet, it is crucial to depend on both types of inquiries to make the best outcome in the children's growth mindset. As children can't get used to following instructions for an outcome while they learn discipline through this practice in guided inquiry. On the other hand, the open inquiry gives more room for innovation and discovery that the child will put in order to reach a result because he has a scientific thinking approach. Especially when the child tastes his work by the end and acquires full ownership and this is how we build leaders. In Open ended Inquiry educators need to value the current Existing knowledge of the Child. Reforming our approach to building executive systems and fostering critical thinking involves shifting from generic activities to engaging with specific content, such as exploring the structure of animal teeth. For example, prompting a child to question what happens when zigzagging inside a crocodile's mouth creates more meaningful inquiry than traditional step-by-step exercises. The tools and methods we choose greatly influence how children develop essential skills and their executive function. The below three figures 6.2.1 E, 6.2. 2 F, and 6.2.3 G , are step 1 introduced by a teacher to a child and how each step 1 generates outcomes in the child's mind and reaction.

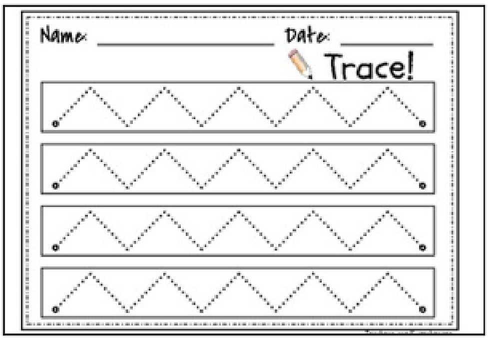

Figure 6.2.1 (E): Classical Figure Tracing a zigzag in an out of context format

Outcomes: The tool is used to build:

1) Motor Skills
2) Vocabulary by knowing the name of the movement
3) Subject Matter Involved: Language, Math

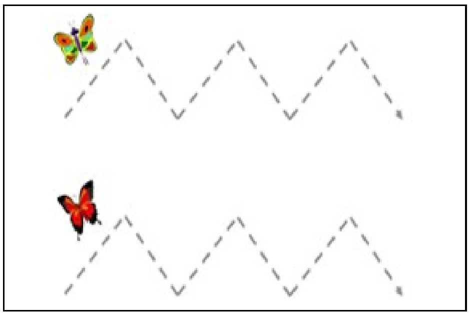

Figure 6.2.1 (F): Patterns Based Figure Tracing a zigzag in an in a half- immersed context

Outcomes: The tool is used to build
1) Motor Skills Training
2) Vocabulary the name of the movement
3) Butterflies flying pattern zigzag
4) Directions: from left to right
5) Reasons behind they fly in zigzag to defend themselves against the birds
6) Subject Matter involved: Science, Math, language, Art

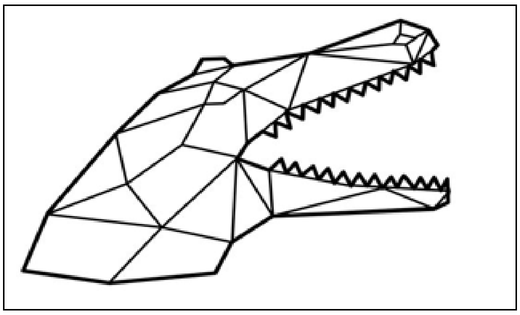

Figure 6.2.1 (G): Patterns Based Figure Tracing a zigzag inside a fully immersed context

Outcomes: The tool is used to build
1) Motor Skills Training
2) Vocabulary the name of the movement
3) Discovery of the animal
4) Open – ended questions raised by the child: "what is this? "and "why is this inside the mouth of the creature?" and "What creature might have zigzag teeth?" "My teeth are not zigzagging!"
5) Comparative analysis and deduction
6) Reasons why these teeth are needed adaptation to diet
7) Hygiene How can he keep so many teeth clean
8) Subject Matter involved: Science, Math, language, Art, risks, Hygiene of teeth, Patterns in the picture that stimulate discovery

Collaborative efforts between educators and families further reinforce executive function skills, ensuring continuity between educational and home environments (Center on the Developing Child, 2024). By thoughtfully weaving guided and open-ended inquiry into educational practice, we empower children to become flexible thinkers, motivated learners, and confident problem-solvers ready to meet the challenges of academic life and beyond. It is in these moments of inquiry, big and small, that the foundations for lifelong success are laid (Vidal Carulla et al., 2021; Scholl, 2024).

7. Conclusion

Unleashing Executive Function and Academic Success Through Inquiry-Based Learning

7.1 Guided and Open-Ended Inquiry as Catalysts for Cognitive Growth

In summary, both guided and open-ended inquiry represent transformative methodologies in early childhood education that deeply enhance the development of executive functions and foster academic achievement. The evidence is clear: when children are engaged in inquiry-driven environments whether through structured support or autonomous exploration they build essential skills such as working memory, cognitive flexibility, planning, and self-regulation (Diamond & Lee, 2011; Doebel, 2020; Blair & Raver, 2015). Guided inquiry provides a scaffolded framework where educators set the stage, allowing children to experiment, reflect, and problem-solve with increasing independence (Edwards, 2022; Istiana et al., 2023; Beagle Learning, 2022). Open-ended inquiry, meanwhile, places learners at the heart of discovery, empowering them to generate questions, pursue investigations, and construct knowledge from real-world experiences (Talafian et al., 2025; Öztürk et al., 2022; Wang et al., 2023).

Both approaches have demonstrated a profound impact on academic readiness, not only by nurturing scientific reasoning and creativity but also by instilling resilience, persistence, and adaptability—attributes linked to success across all domains of learning (Best, Miller, & Naglieri, 2011; Center on the Developing Child, 2024). Inquiry-based learning frameworks mirror the natural curiosity and exploration that young children bring to their environments, leveraging their intrinsic motivation for lifelong cognitive growth (Gopnik, 2012; Van Herwegen, 2024).

7.2 Recommendations for Educators and Parents

To effectively nurture executive function and holistic development, educators and parents are encouraged to regularly integrate guided and open-ended inquiry into daily routines. Activities such as storytelling, cooking, and collaborative problem-solving foster questioning, experimentation, and reflection, balancing autonomy with structured support (Beagle Learning, 2022; Doebel, 2020; Blair & Raver, 2015; Galuert, Heal & Cook, 2003; Summit Ranch, 2025). Open-ended challenges promote creativity and self-directed learning, while guided inquiries scaffolded with thoughtful prompts and constructive feedback enhance confidence, self-regulation, and deeper understanding (Edwards, 2022; Istiana et al., 2023; Talafian et al., 2025; Wang et al., 2023).

In closing, When we dare to create challenging learning situations while remaining present and supportive as coaches, we offer children a richer context for growth. This approach nurtures deeper confidence and more resilient skills than step-by-step spoon-feeding ever could. Fostering challenging yet supportive learning environments provides children with the richest opportunities for growth. When educators and families work in tandem integrating both guided and open-ended inquiry into daily practice children develop not only flexible thinking and confidence, but also the motivation and resilience essential for lifelong success. By being present as thoughtful guides, rather than offering overly prescriptive steps, we empower children to become creative problem-solvers, ready to embrace the complexities of learning and life. It is within these moments of genuine inquiry and discovery that the strongest foundations for future achievement are built.

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