



Principles of Science Curriculum Design for Taiwanese Preschools: Three Dimensions of Integrating IEP Into Science Learning for Young Children

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ARTICLE INFO	ABSTRACT
Published Online: 02 February 2026	Within this theoretical framework, the IEP is not merely a legal and administrative document but can also be understood as a pedagogical design tool. By embedding individualized goals and support strategies into everyday science inquiry activities, teachers are able to respond to children's differences in developmental pace, expressive ability, and social interaction within a shared curriculum structure. The integration of IEP and early childhood science learning not only addresses individual needs but also deepens the practice of differentiated instruction in inclusive educational contexts. This article explores the potential integration of the Individualized Education Program (IEP) into early childhood science learning, grounded in the principles of differentiated instruction and inquiry-based education. The aim is to provide young children with more individualized and responsive science learning experiences. Differentiated instruction emphasizes that teachers should adjust curriculum goals, instructional processes, and the forms of learning outcomes according to learners' differences in ability, interests, and readiness, thereby promoting active participation and effective learning for every student. Through differentiated curriculum design, teachers are able to
Corresponding Author: Yi-Huang Shih	address both the collective needs of the class and the individual needs of each child within a shared curriculum structure, fostering a truly inclusive science learning environment.
KEYWORDS: Individualized Education Program (IEP), Early Childhood Science Learning, Young Children	

1. INTRODUCTION

Early childhood science education is not merely the transmission of factual knowledge; rather, it is an inquiry-driven process that nurtures young children's innate curiosity and cognitive development. Constructivist

approaches to science education have gained increasing attention due to their emphasis on learner-centered instruction, active engagement, and knowledge construction. These approaches highlight children's active role in making sense of experiences and underscore the importance of learning as a

socially mediated process, facilitated through interaction with peers and adults (Bruner, 1960; Piaget, 1952; Shih, 2025a; 2025b; Vygotsky, 1978). The principles of constructivist science education align closely with the framework of the Individualized Education Program (IEP), which emphasizes responsiveness to individual differences, strengths, and learning needs (Turnbull, Turnbull, Wehmeyer & Shogren, 2015). IEPs focus on personalized goals, adaptive instructional strategies, and ongoing assessment, enabling each child to progress at their own developmental pace. In the context of early childhood science education, integrating IEPs allows educators to operationalize constructivist principles by differentiating inquiry tasks, scaffolding exploration activities, and providing multiple means of representation and expression (Tomlinson, 2014).

The Individualized Education Program (IEP) is widely recognized as the heart of providing a free appropriate public education and serves as the cornerstone of the Individuals with Disabilities Education Improvement Act (IDEIA) of 2004. It is the central mechanism through which effective and legally compliant program design, implementation, monitoring, and enforcement are ensured. Functioning as a roadmap for special education (SE) services, the IEP translates legal mandates into individualized educational practice (Diliberto & Brewer, 2012; Rotter, 2014). This article examines the integration of the Individualized Education Program (IEP) into early childhood science learning from the principles of differentiated instruction and inquiry-based education, with the aim of providing young children with more individualized and responsive science learning experiences. Differentiated instruction emphasizes that teachers should adjust curriculum goals, processes, and forms of learning products according to learners' differences in ability, interests, and readiness in order to promote participation and learning for every student (Tomlinson, 2014).

Inquiry-based education, on the other hand, argues that learning should be rooted in authentic problem contexts and guided through questioning, hands-on exploration, dialogue, and reflection, enabling learners to actively construct knowledge (Bruner, 1961; Dewey, 1938). Within this theoretical framework, the IEP is not merely a legal and administrative document but can also be understood as a pedagogical design tool. By embedding individualized goals and support strategies into everyday science inquiry activities, teachers are able to respond to children's differences in developmental pace, expressive ability, and social interaction within a shared curriculum structure (Friend & Bursuck, 2019). Empirical studies further indicate that integrating IEPs with inquiry-oriented curriculum design enhances children's learning engagement, conceptual understanding, and sense of self-efficacy (Diliberto & Brewer, 2012; Rotter, 2014). Accordingly, the integration of IEP and early childhood science learning not only addresses individual needs but also deepens the practice of differentiated instruction in inclusive educational contexts.

This article is a conceptual/theoretical framework, rather than an empirical study, and explores the potential integration of the Individualized Education Program (IEP) into early childhood science learning, grounded in the principles of differentiated instruction and inquiry-based education. The aim is to provide young children with more individualized and responsive science learning experiences. Differentiated instruction emphasizes that teachers should adjust curriculum goals, instructional processes, and the forms of learning outcomes according to learners' differences in ability, interests, and readiness, thereby promoting active participation and effective learning for every student (Tomlinson, 2014). Through differentiated curriculum design, teachers are able to address both the collective needs of the class and the individual needs of each child within a shared curriculum

structure, fostering a truly inclusive learning environment.

2. WHAT IS IEP

The Individualized Education Program (IEP) is a plan mandated in the United States in 1975 requiring schools to design an individualized program for each student with disabilities. It is developed through a comprehensive analysis and evaluation of the student’s family background, interests, academic achievement, and cognitive style. The IEP is collaboratively designed by educational professionals and parents through ongoing communication and cooperation, and it is continuously reviewed and revised based on the student’s learning progress. The original purpose of the Individualized Education Program (IEP) was for it to serve as an accountability device, it has become an instructional as well as evaluative mechanism. In sum, the Individualized Education Program (IEP) is not synonymous with individualized instruction alone. Rather, it encompasses the following key principles: (1) It is grounded in the concept of individual differences. (2) It provides individualized educational assessment for each student with special needs. (3) It formulates individualized educational goals and strategies that are appropriate to the student’s abilities and needs. (4) It employs a variety of instructional approaches suited to the student’s learning characteristics to guide the achievement of individualized goals. (5) It uses individualized standards to regularly evaluate the student’s progress toward these goals and to seek continuous improvement (Goodman & Bond, 1993; Grigal, Test, Beattie & Wood, 1997; Landmark & Zhang, 2012).

3.THREE DIMENSIONS of INTEGRATING IEP into SCIENCE LEARNING

3.1 Multi-Level Goal Setting

Within shared science activities, teachers can establish both common learning objectives and individualized goals aligned

with children’s IEPs. For example, in a “plant growth observation” activity, the general goal may be for all children to understand the basic conditions for plant growth, while individualized goals for children with IEPs may focus on using pictures or single words to express observations or completing simplified procedural tasks (Gillies, 2023).

This approach reflects the core principles of differentiated instruction and Universal Design for Learning (UDL), in which teachers proactively design flexible learning environments that respond to children’s diverse abilities, interests, and modes of expression (CAST, 2018; Tomlinson, 2014). Rather than separating children with IEPs from shared inquiry activities, their individualized goals are embedded within the overall learning process, enabling all children to participate meaningfully in hands-on investigation, observation, and discussion within the same scientific context. For example, in a “plant growth observation” activity, the use of visual prompts, simplified procedures, and multiple modes of expression (e.g., oral language, picture cards, pointing, or bodily movement) not only supports the participation of children with special needs but also helps typically developing peers better understand scientific processes, thereby enhancing the accessibility and interactivity of learning. From a sociocultural perspective, such practices align with Vygotsky’s concept of the Zone of Proximal Development (ZPD), which emphasizes that learning occurs through guided participation and scaffolding (Vygotsky, 1978). Through intentional adjustments—such as breaking tasks into smaller steps and modeling observational and descriptive language—teachers enable children with IEPs to engage in scientific reasoning and expression at a level slightly beyond their independent capabilities. As children’s competence and confidence increase, these supports can be gradually faded, thereby promoting autonomous participation and inclusive learning.

Furthermore, embedding IEP goals within inquiry-based science activities strengthens coherence among curriculum, instruction, and assessment. Through daily practices such as observation records, learning portfolios, and documented dialogues, teachers can collect authentic evidence of children’s performance in core cognitive abilities, including information gathering, information organization, and problem solving. Such evidence serves as a basis for monitoring IEP progress and reduces reliance on pull-out assessments. In this way, science learning contexts become not only sites of knowledge construction but also dynamic spaces for enacting inclusive assessment and responsive teaching.

2.2 Multi-Sensory and Hands-On Learning Processes

Early childhood science learning is fundamentally sensory and experiential in nature. Grounded in constructivist learning theory, young children construct knowledge through direct interaction with materials, environments, and others (Dewey, 1938; Piaget, 1952). The use of real objects, visual representations, bodily movement, and hands-on manipulation transforms abstract scientific concepts into concrete and meaningful experiences. From the perspective of differentiated instruction and Individualized Education Programs (IEPs), multisensory design allows teachers to adapt content, learning processes, and expected outcomes in response to children’s diverse developmental profiles (Tomlinson, 2014). Empirical studies indicate that multisensory approaches significantly enhance engagement and conceptual understanding for children with language delays, attentional difficulties, and social–communication challenges (Shams & Seitz, 2008; Mastropieri et al., 2009). By providing multiple access points to scientific concepts, multisensory instruction aligns curriculum goals with individual IEP objectives and supports equitable participation in early childhood science learning.

3.3 Scaffolding and Structured Guidance

Dewey advocates that schools should provide a true social life and assess the psychology of individual children. Therefore, school activities should allow children to express their abilities, tastes, and needs appropriately. Teachers can provide clear learning structures through verbal prompts, step cards, modeling, and systematic repetition. These forms of instructional scaffolding are central to sociocultural and constructivist perspectives on learning, which emphasize the role of guided participation in supporting children’s engagement within their zone of proximal development. For children with Individualized Education Programs (IEPs), such structured supports create predictable and manageable learning contexts in which they can meaningfully participate in inquiry-based science activities. Empirical research suggests that explicit prompts, visual sequencing tools, and modeling strategies enhance task persistence, attention, and conceptual understanding among young children with developmental and learning needs (Lin & Shih, 2025; Mastropieri, Scruggs & Graetz, 2009; Shih, 2026; Vygotsky, 1978; Wood, Bruner, & Ross, 1976; Ye & Shih, 2021). In this way, structured scaffolding not only supports access to inquiry processes but also aligns classroom practice with individual IEP goals.

4. IMPLICATIONS

An Individualized Education Program (IEP) is a legally mandated document under the Individuals with Disabilities Education Act (IDEA) that outlines a tailored educational plan for students with disabilities. The purpose of an IEP is to ensure that children with disabilities receive a Free Appropriate Public Education (FAPE), designed to meet their unique needs and help them achieve academic and developmental goals (IEP Central, 2026). The integration of the Individualized Education Program (IEP) into early

childhood science learning carries significant implications for both educational policy and teacher education. From a policy perspective, curriculum frameworks and special education regulations should more explicitly promote the alignment of IEP goals with inquiry-based and differentiated instructional practices, rather than positioning IEP implementation as a parallel or isolated system. Consistent with inclusive education theory, effective policy should support coherence among curriculum, instruction, and assessment to ensure that individualized supports are embedded within everyday classroom activities (Florian & Black-Hawkins, 2011). Empirical research further suggests that systemic support—such as collaborative planning time, interdisciplinary teamwork, and sustained professional development—enhances teachers’ capacity to enact inclusive and responsive practices in early childhood settings (Friend & Cook, 2013; Darling-Hammond et al., 2017).

At the level of teacher education, both preservice and in-service programs should prioritize the preparation of early childhood educators to design and implement inquiry-oriented, differentiated science curricula that meaningfully integrate IEP goals. This includes developing competencies in Universal Design for Learning (UDL), formative assessment, and collaborative IEP planning (CAST, 2018; Tomlinson, 2014). Studies indicate that teachers who receive targeted preparation in inclusive pedagogy demonstrate greater confidence and effectiveness in supporting children with diverse learning needs within mainstream classrooms (Forlin & Chambers, 2011; Sharma, Loreman, & Forlin, 2012). Strengthening teacher education in these areas is therefore essential for advancing equitable and high-quality early childhood science education.

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