University of Baghdad
College of Engineering
JE
JOURNAL OF ENGINEERING

Journal of Engineering

journal homepage: www.jcoeng.edu.iq

Volume 32 Number 1 January 2026

Children's Perception and Learning Skills: Implications in Kindergarten Architecture

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ABSTRACT

Kindergarten architecture plays an important role in shaping children's perception and learning. However, many designs still fail to systematically translate educational theories into tangible spatial solutions. This gap highlights the research problem addressed in the present study as the absence of integrated architectural indicators that connect children's perceptual development, learning styles and philosophical ideas with the design of kindergartens. The aim of the paper is to develop a consistent set of design indicators which could lead to the creation of a captivating learning environment by the architects as well as the educators. In the methodological approach, the study determines six types of learning styles: cognitive, social, sensorimotor, cooperative and play-based learning. It resorts to a literature-based synthesis of theories of perception and learning with focus on the preoperational stage, simultaneously incorporating the philosophical and pedagogical work of the theorists who first began to explore the concepts, namely, Froebel, Montessori, Decroly, McMillan and Dewey. All these theoretical considerations resulted in the development of a set of abstract architectural indicators that have the priority to provide the basis of their practical application to the kindergarten environment. Such indicators were applied to Šmartno Kindergarten to demonstrate how abstract concepts can be translated into architectural practices. The research concluded that subjecting the kindergarten design to the theories of perception and learning promotes the curiosity, creativity and the overall development of children, in addition to supplying the architects or the designers with pragmatic guidelines for early-childhood design.

Keywords: Child's perception, Kindergarten architecture, Learning skills, Active learning, Cognitive development, Social interaction, Play-based learning.

1. INTRODUCTION

Designing kindergartens is one of the most significant architectural challenges, requiring both a deep understanding of children's psychological and educational needs and technical knowledge in design and construction **(Kotnik, 2018).** Children's cognitive processes at

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Peer review under the responsibility of University of Baghdad.
https://doi.org/10.31026/j.eng.2026.01.06

Article received: 27/07/2025
Article revised: 23/08/2025
Article accepted: 26/08/2025
Article published: 01/01/2026

these sensitive ages depend heavily on their surrounding environment, making architecture in this context not merely the creation of physical spaces, but an effective tool in enhancing children's learning and holistic development **(Mostafa, 2024).** The built environment plays a vital role in a child's development, shaping their personality as well as their cognitive and emotional orientations, as children actively engage with these environments and utilize them to fulfill their unique needs, such as questioning, innovation, experimentation and exploration, which enhances their cognitive and social development. Therefore, kindergarten is an important stage in the child's life, as it is a vital educational environment that meets the child's cognitive, social and emotional skills **(Evans, 2006).**
The architectural design of kindergartens creates important psychological and social developmental possibilities, along with enhancing imagination and creative thinking skills in young children. Open areas with interactive activities drive children to take part in activities during which they develop social abilities and new learning skills for acquiring social norms **(Finley and Wiggs, 2016).**
A good kindergarten environment also plays a significant role in children's development, as carefully designed environments provide spaces for children to explore their natural, physical, and social environment, which enhances their cognitive development. Participating in various activities and being exposed to new spatial elements helps children learn new skills, develop their knowledge, encourage curiosity and exploration, and enhance social interaction among children, which positively impacts their psychological and emotional development **(Hamayoun, 2021).**
Children's health along with their development in kindergarten settings primarily depends on architectural design that remains in peaceful harmony with nature. These features of good ventilation combined with natural light together fight respiratory diseases and create better moods, but natural settings including green areas work to minimize stress and achieve better psychological wellness. The availability of open play areas leads children to engage in physical activity thereby improving both their health and their immune system operations. Students learn more creatively and socially when educational areas are designed interactively and with flexibility which stimulates their sensory perception and their skills to actively learn **(Al-Alwan and Al-Baik, 2017).**
Studies on kindergartens **(Homayooni et al., 2016; Lithi, 2020; Ho, 2023)** confirm a positive relationship between a rich and stimulating environment and children's development, as the environment influences the children's attitudes, behaviors, and plays a significant role in shaping their personality in terms of emotional, mental, and psychological development. Therefore, kindergarten architecture has been the subject of numerous studies from various perspectives. **(Kotnik, 2018)** examined the relationship between the design of early childhood spaces and children's development, focusing on the role of educational environments in stimulating learning and fostering creativity. By reviewing a group of global kindergarten and nursery design projects, and providing analyses of each project, the essential design elements were highlighted, including the function and quality of the space, its impact on the child's learning and development experience, and how it can be used to provide rich sensory experiences to support children's learning and self-exploration. The study highlighted the importance of educational philosophy in the design of early childhood spaces and the theoretical foundations that link experiential learning with the design of educational spaces. The focus was on the importance of designing indoor and outdoor spaces in a way that encourages independence, creativity, and social interaction, while integrating nature into learning environments by designing green spaces, natural playgrounds, and

educational gardens that provide opportunities for children to interact directly with the surrounding environment.

(Al-Alwan and Muneeb, 2015) provided design solutions for nurseries and kindergartens to create urban environments that are appropriate and supportive of children's growth and development. The study presented a comprehensive architectural model that reflects the psychological and educational needs of children, with a focus on the critical importance of early childhood, especially the first years of a child's life and its importance in shaping intelligence and basic skills. It also highlighted the importance of play for children. The study reviewed the three educational intellectual approaches (Froebel, Montessori, and Baklin) and their impact on the requirements of child-friendly architecture, leading to strategies for planning and designing nurseries and kindergartens by creating a sustainable and child-friendly learning environment**.**

(Dziobek-Bepler, 2021) highlighted the need for child-specific environmental design which supports development through stimulating learning spaces that architecture together with interior design creates for children. The research established fundamental design rules to build childcare facilities that healthcare organizations can use for their pediatric medical clinics. Accepting child exploration through space design demands an approach which acknowledges that children express space differently than adults using physical movement and sensory perception**.** Meanwhile, **(Ho, 2023)** demonstrated how to build interactive creative learning environments through his current architectural perspective. The study examined thirty creative immersive and interactive spaces around the world including schools as well as after-school care centers and kindergartens alongside activity centers (clubs and cultural centers) and additional child-oriented environments. The study investigated methods to establish interactive educational spaces through innovative flexible design elements which trigger responsive child-based space interactions. The study demonstrates that interactive design needs open spaces with flexible furniture to enable freedom of movement to improve both cognitive and sensory development in children. It is accomplished due to the visual elements and natural elements whereby the colors, natural sunlight and wood are used to create comfortable and stimulating environments to the senses. **(Meuser, 2019)** discussed the notion of research-based design and its importance to create the most perfect learning environment in children. The study focused on how architectural space affects children's sensory perception and cognitive development by studying kindergartens and analyzing the role of design in stimulating learning and exploration. The study focused on ten basic criteria for designing buildings for children, aiming to create architectural environments that support children's holistic learning and development: urban context, entrance area, building form, interior design, interaction space, young children, safety and security, open spaces, acoustics standards, signage, and educational tools**.** The study emphasized the importance of modular and flexible design in providing environments that are adaptable to children's needs. Hence, kindergartens are not merely places for learning information; they are comprehensive environments that provide children with opportunities for social interaction, learning about the natural world, participating in physical activities, and acquiring and developing new skills. These environments enhance children's educational experience and support their emotional and social development.

As a result, the earlier research highlights the necessity of creating kindergarten spaces that encourage children's comprehensive development by incorporating environments rich in opportunities for creativity and interactive learning using the senses and through

movement. Enhancing learning is achieved by designing environments that combine natural and interactive features to deliver a stronger and more supportive educational environment. Such spaces should be arranged to be both flexible and adaptive, so they reflect and promote the psychological and educational needs of children. Despite the growing body of literature emphasizing the importance of kindergarten environments for children's holistic development, there is still a lack of integrated architectural indicators that directly link theories of perception, learning styles, and philosophical ideas to the practical design of kindergarten spaces. This gap limits the ability of architects to systematically translate educational theories into tangible spatial solutions.

This research seeks to provide a general framework that links theories of perception and learning with educational ideas, thus opening the way for adopting design principles that are more aware of the characteristics and needs of the child in the early childhood stage.

2. THEORETICAL FRAMEWORK

2.1 The Development of Perception in Children

Psychologists and sociologists emphasize the reciprocal relationship between children and their environment, with each influencing the other. The built environment plays a fundamental role in shaping children's behavioral choices, as their visual perception relies on neural processes that organize and process sensory information received through the senses. Children explore their surrounding environment meticulously through their field of vision, which helps them organize and understand their surroundings more clearly **(Naama, 2008).** The mechanism of visual perception involves the eye, as a visual sensory organ, capturing images from the surrounding environment and transmitting them to the brain, which in turn analyzes them and produces appropriate responses and interpretations. Studies have classified children's perception into several stages, including: attention, sensation, feeling, sensory perception, and cognitive perception.

- Attention: represents the process of directing a child's mind toward a specific object until it becomes the focus of awareness, allowing them to perceive and respond to it.
- Sensation: is defined as the psychological effect resulting from the interaction of one of the senses with external stimuli, which is then transmitted to the sensory centers in the brain.
- Feeling: is an emotional response resulting from an external stimulus and manifests through physiological changes. Feelings can be positive (such as happiness, joy, activity, and courage), or negative (such as sadness, anger, fatigue, and fear) **(Khalaf, 2017).**
- Sensory perception: is the process by which children interact with and understand their surroundings through the five senses, with the environment playing a fundamental role in shaping this experience. Sight greatly influences a child's interaction with the components of perceived space by interpreting sensory stimuli, such as natural light, colors, and different materials, which contributes to the development of their cognitive responses and strengthens their connection to space **(Meuser, 2019).**
- Cognitive perception: perception is considered a cognitive organizational process that relies primarily on children's sensory experience. It is an active experience in which the child obtains information through movement, which contributes to shaping their behavior and interaction with the world around them. Initially, the child experiences these stimuli through their senses, as these initial responses are the basic input to the perception process. Subsequently, the child organizes, evaluates, and interprets sensory information

based on their previous experiences, leading to the formation of their concept of perception. This perception is directly influenced by how they respond to these stimuli **(Al-Alwan and Abdullah, 2009).** Just as each sense is unique, each child's perception is also unique. During perception, encoded information changes in alignment with additional information and becomes subjective depending on the child's identity, past, and memory, Therefore, the child is not merely a passive recipient of environmental information; rather, he or she is an organism capable of selecting, storing, and analyzing various pieces of information. Their perception develops particularly when they begin to move. Through their movement, they explore their surrounding world through their senses, which enhances their active interaction with their surroundings and contributes to their perceptual and cognitive development **(Turgay and Sarıberberoğlu, 2022).**

Jean Piaget, a Swiss psychologist and philosopher, is considered one of the most influential scholars of developmental psychology. In his work, he stresses the fact that children are not mere receivers of the knowledge but also participants in the process of creating their own world understanding **(Lourenço and Machado, 1996).** He described four stages of a child's cognitive development **(Piaget and Inhelder, 1969):**

- The Sensorimotor Stage (from birth to two years). **(Lourenço and Machado, 1996)**
- The Preoperational Stage (from two to seven years).
- The Concrete Operational Stage (from seven to eleven years).
- The Formal Operational Stage (from eleven years and older).

The present article focuses on the pre-operational stage, which is called the early childhood stage, extending from the end of the second year to the end of the sixth year. This is considered one of the important stages in a person's life, in which the child begins with complete dependence on others and then begins to advance in growth towards independence and self-reliance. The most prominent changes that occur in the child in the early childhood stage can be observed through:

- Motor development:

Children's motor activity at this stage is characterized by continuous vitality, as their physical activity increases to include speed, precision, strength, and variety of movements. Their ability to control their limbs gradually develops, and they are able to better control their muscles, allowing them to engage in activities such as climbing, jumping, hopping, and riding a tricycle, in addition to other movements that require balance. The child also begins to control their small muscles, but the coordination between their sense of sight and finger movements has not yet reached full maturity, making them more vulnerable to falls while moving **(Al-Alwan and Muneeb, 2015).**

So, this stage is characterized by the complete development of the child's large muscles and their ability to control them. They begin to attempt to control their small muscles through activities that contribute to their development, such as clay work.

- Mental development:

This stage represents a transition from external sensory-motor actions to internal mental processes. The child begins to learn to use symbols and his vocabulary expands. He also begins to employ the words he has learned to express the things he sees around him. Since the child's perception of the world around him does not accurately reflect reality, he may sometimes speak about imaginary topics as if they were real. For this reason, imaginary or pretend play becomes more prevalent at this stage, as the child treats dolls as if they were living beings, interacts with them, converses with them, and gives them feelings and

behaviors similar to those of humans. Moreover, at this age, the child is not yet fully able to distinguish between reality and fantasy, which allows him to freely integrate into his imaginary world **(Al-Alwan and Muneeb, 2015).**
So, this stage is characterized by rapid and significant mental growth. Providing diverse and rich activities, as well as construction and building games, contributes to the development of his mental growth.

2.2 Children's Learning Styles

Learning is a dynamic process that enables individuals to acquire new knowledge and develop their skills and behaviors over time. Learning is a relatively permanent change in behavior or knowledge resulting from experience, exploration, and interaction with the environment and other individuals **(Casha, 2015).** This dynamic process plays a fundamental role in children's development, as they learn through their interactions with their school and social environments. By listening and participating in educational activities, children acquire life and learning skills that help them adapt and grow personally.
Children's learning depends on their responses to the surrounding environment, which is a key catalyst for developing various cognitions and skills. Therefore, kindergartens require a carefully designed learning environment that is integrated with modern learning theories, which are now fundamental principles in the development of the educational process to support children's cognitive, sensory, social, and motor development **(Casha, 2015).** These theories include:

2.2.1 Cognitive Learning

Jean Piaget is a pioneer in the study of cognitive development in children. He developed a theory focusing on how intelligence grows in children through multiple stages. The theory is concerned with how knowledge grows in an individual through the multiple stages of his development by explaining the quantitative and qualitative changes that occur in the individual's perception and thinking. The theory presupposes that the way the child perceives this world and his way of thinking about it vary in different stages of age because in each of them the special ways and algorithms of thinking are dominant, which determine the way the child perceives things and influence his behavioral patterns. Piaget believes that cognitive construction is multiple and diverse according to the nature of the environmental experiences to which the child is exposed, as they increase in number and complexity as a result of the processes of continuous interactions with environmental stimuli. According to the theory, learning involves more than responding to outside stimuli because it includes multiple steps such as information organization, followed by storage, then retrieval, and finally transforming the information into new applications **(Al-Zaghloul, 2019) .**

2.2.2 Social Learning

According to Lev Vygotsky (1896-1934) social interaction with others leads to learning through which people develop their understanding and perception. The interaction with their social environment guides their perception while building their understanding of things. Social constructivism theory guides his work to show that learning develops through social relationships. Learning activity depends strongly on both historical background and cultural factors according to **(Othman et al., 2017).**

Social learning relies on learning that happens through the combination of modeling alongside observation together with direct interaction because these approaches serve as vital fundamentals. Learning takes place through a combination of imitation and real-world experiences for children. There are several strategies for social learning:

- Talk-based instruction: serves as an effective method to promote learning through linguistic correspondence in classrooms. The learning process expands both mental concepts and critical thinking capabilities **(De Felice et al., 2022).**
- Observational learning: takes root when children study the behaviors of others in their environment. When children observe someone, they like to learn to duplicate the behavior, which serves as an important step in the creation of cognitive concepts **(Othman et al., 2017).**
- Group communication: children benefit from group communication to acquire social principles as well as social skills through this technique. Students will develop better cognitive abilities through the shared practice of cooperation and sharing methods with their classmates **(De Felice et al., 2022).**
- Interactive play: The basic method for triggering sensory development and cognitive learning is interactive play. Children develop their abilities because direct environmental exploration becomes possible through this method **(Othman et al., 2017).**

A stimulating social environment requires spaces which enable interaction and support group activities. The environment should enhance both child interactions while also supporting collective group actions. The primary focus is on a dynamic design that enables the maintenance of three key elements: learning, playing, and social interaction. According to **(Finley and Wiggs, 2016)** these areas need to promote both flexibility and creativity**.**

2.2.3 Sensory and Motor Learning

The development of perception and cognitive abilities, along with skills, depends on improving sensory perception and physical movement in children. The design approaches child development by uniting sensory and motor activities within a complete educational framework, which helps children develop physically and emotionally while keeping their mental strength stable **(Bers et al., 2018).** Sensory learning is a result of interaction between children and the external environment, which they have the five faculties of sense of sight, hearing, touch, smell and taste. Through this process, students enhance their capabilities to see and hear as well as learn how to differentiate various pieces of information. Learning experiences through physical activity offer support to students for developing both their fine motor abilities, including writing and drawing, and their gross motor abilities, including running and jumping, enhancing body-mind coordination. By linking motor activity with sensory experiences, brain development, as well as problem-solving and innovation skills, is all enhanced **(Hanták and Končeková, 2023).**

2.2.4 Cooperative Learning

Cooperative learning is an educational strategy where children work together in small groups through structured group activities to achieve a common goal. This contributes to the development of critical thinking and problem-solving. Studies have shown that it achieves superior results to individual and competitive learning approaches. Cooperative learning

helps develop social skills, interaction, and cooperation among children from diverse cultural backgrounds. This approach promotes emotional and cognitive development in a fun and supportive environment. Cooperative learning is essential for enhancing a child's cognition and learning abilities **(Gillies, 2014).** Cooperative learning emphasizes:

- Interaction: encouraging communication and teamwork.
- Shared responsibility: each child contributes to the group's success.
- Social skills: building empathy, respect, and cooperation.
- Active learning: participating in problem-solving, exploration, and creativity **(Gillies, 2014) .**

The study by **(Puspita et al., 2024)** explored the case of the so-called Green Lab in the kindergarten of Palembang City where 30 children took part in shared plantation, waste treatment, and cultivating plants. This collaborative work raised environmental awareness, built teamwork, communication, and problem-solving skills and encouraged children to grow socially and emotionally. In the same breath, **(Al-Shami et al., 2024)** pointed out the importance of cooperative learning in establishing an inclusive child-friendly society.

2.2.5 Active Learning

Active learning is an educational approach that engages children in hands-on, exploratory, and collaborative activities. Active learning encourages curiosity, creativity, and critical thinking through direct interaction with the environment. The interactive design of children's environments supports active learning and fosters a stimulating atmosphere where children can thrive cognitively, socially, and emotionally **(Taylor, 2009).** Active learning focuses on:

- Child-centered activities: children actively participate in their own learning process rather than passively receiving information.
- Exploration and experimentation: opportunities for discovery through play and interaction with materials.
- Participation and collaboration: involves social interaction and teamwork to solve problems or complete tasks **(Bers et al., 2018).**

Active learning transforms children's environments into vibrant and engaging environments where children's natural curiosity and energy drive their development. By designing spaces and activities that encourage exploration, interaction, and creativity, educators can create a rich foundation for lifelong learning. Design that focuses on active learning not only stimulates cognition and learning but also nurtures each child's potential in a fun, practical, and meaningful way **(Bers et al., 2018).**

2.2.6 Learning through Play

Learning through play is a fundamental approach to early childhood education, emphasizing the role of structured or guided play and free play in stimulating children's perception, cognitive abilities, and social and emotional development. Free play provides children with the freedom to explore and experiment independently, while guided play allows adults to provide guidance and reinforce learning indirectly. A well-designed play environment integrates sensory, physical, and intellectual elements, fostering a rich and engaging experience **(Kangas, 2010).** Play environment design plays a fundamental role in children's

education by stimulating exploration, social interaction, and active learning. Carefully designed spaces provide a rich environment that supports free and guided play. Key characteristics of an environment that promotes learning through play are flexibility and diversity, allowing children freedom of movement and exploration and providing open, multi-use spaces. Furthermore, the design must be adaptable to children's different needs, allowing teachers to modify spaces and add interactive materials that support learning in a fun and effective way **(White, 2012) .**

According to **(Moore et al., 2014)**, play-based learning designed to foster children's overall growth by play was shown to be a valuable approach for promoting the learning of cognitive, social, and emotional skills according to the study. Children used diverse play approaches to acquire new skills, for example, by participating in symbolic play with dolls and costumes to act out characters. Using blocks and art materials in constructive play helped children build problem-solving skills, and physical play supported improvements in both motor development and the coordination of the senses. The study called attention to the need for adaptable and interactive learning spaces, organized as different corners (quiet play corner, motor play corner, and imaginative play corner), and enriched with resources that encourage imaginative and free exploration by children. The method reinforces the idea that young children learn through direct experience in addition to what is taught, and that this learning happens best in stimulating and safe settings. As a summary of the points discussed above, **Table 1** illustrates the foundations and characteristics of learning styles.

The fundamental concepts of major learning theories (cognitive, constructivist, and social) have led to the emergence of modern learning approaches that enable us to improve educational processes. The process of designing a learning environment for children relies heavily on different learning styles, as these frameworks determine how children interact with their environment and master their abilities. Integrating the concepts of these theories into environments specifically designed for children allows for the development of comprehensive learning plans that meet the diverse needs of learners and help them assimilate learning and apply skills effectively. These concepts enable teachers to create better learning environments that foster the development of children's intellectual and social abilities.

The following section discusses the philosophical and educational concepts of the pioneering theorists who developed their ideas based on children's perception and learning skills. Their concepts had a great impact on promoting the design and architecture of kindergartens.

Table 1. Foundations and characteristics of learning styles

Learning style	The foundations on which it is based	Style properties
Cognitive learning	It relies on the development of intelligence across multiple stages, with thinking changing according to each age. It focuses on organizing, storing, and retrieving information. **(Al-Zaghloul, 2019)**	It promotes logical and experimental thinking, and helps children develop cognitive strategies for absorbing and analyzing information.
Social learning	It is based on social interaction, imitation, and observation to acquire knowledge. Learning occurs through interaction with peers and teachers. **(Othman et al., 2017; De Felice et al., 2022)**	It relies on dialogue and social communication, and enhances children's understanding of concepts through imitating others and participating in group activities.

Sensory and motor learning	It relies on stimulating the five senses and linking them with physical movement to support cognitive, emotional, and physical development. It includes play, exploration, and direct interaction. **(Hanták and Končeková, 2023).**	It contributes to enhancing brain development by linking motor activity such as jumping, balancing, and fine motor activities (such as drawing and writing) with sensory experiences. It improves problem-solving and innovation skills.
Cooperative learning	It is based on teamwork, where children cooperate in small groups to achieve a common goal. It focuses on social skills and active interaction. **(Gillies, 2014; Puspita et al., 2024)**	It promotes shared responsibility among children, and encourages the development of negotiation skills, cooperation, and active participation in problem-solving.
Active learning	It encourages children to explore and interact with the environment in hands-on ways, and fosters critical thinking and creativity through direct experimentation. **(Taylor, 2009; Bers et al., 2018)**	Encourages children to investigate and explore through interactive, hands-on, experiential activities that stimulate curiosity and independence.
Learning by playing	Free and guided play act as principle learning tools because they assist in constructing social, sensory and cognitive abilities. **(Kangas, 2010; White, 2012)**	Through free and guided play children learn and the emphasis lies on diverse environments that have flexibility in their setup.

2.3 Philosophical and Educational Ideas Promoting Kindergarten Architecture

Nineteenth-century societies demonstrated a fundamental change in their beliefs regarding child education through the development of kindergartens. Traditional ideas focused on rigorous education and academic training for children from an early age. Although the idea of infant schools had spread since the beginning of the eighteenth century, they did not receive sufficient attention from educators. They did not have clearly-defined curricula, educational goals, or a distinct name independent of primary education until the well-known educator Friedrich Frobel (1782-1852) emerged. He devoted his educational efforts to developing infant schools, as the emergence of his philosophy represented a decisive turning point **(Al-Alwan and Muneeb, 2015).**

Frobel believed that young children learned a great deal through free play, especially in the garden. He opposed the restrictive system of the time, which sought to break children's will. His philosophy focused on creating an educational environment that respected the child's innate nature and enhanced their individual abilities through play and natural interaction with the surrounding environment. The kindergarten served as a safe and stimulating haven where children could freely express themselves and develop their social, emotional, motor, and language skills. Frobel developed an educational system that emphasized the importance of practical and experiential activities, allowing children to learn through their personal experiences and exploration of the world around them. The kindergarten provided a safe and stimulating environment that enabled children to express themselves freely and enhanced their social and emotional skills, along with their motor and language skills. Froebel's educational concepts spread throughout the world and became the basis for the creation of kindergartens and elementary schools that used his approach to develop

interactive educational programs for children **(Al-Sharif, 2014).** Madame Maria Montessori (1870-1952) is considered one of the most famous people who were interested in education, especially early childhood education in Italy. She is the founder of an educational method known as the "Montessori Method". Montessori attempted to refine Frobel's method and then extract new educational views that influenced the curricula and organization of kindergartens and brought about a major development in the field of raising young children. She was probably the first teacher to focus on learning through play and furniture appropriate to the size of children **(Dudek, 2001).** Montessori established her first school in Italy in 1907 for children between the ages of three and seven. It was known as the case "Bambini" and she applied her method of raising children, which was based on the child's self-activity without direct intervention. She prepared an educational environment for the purpose of teaching children by means of educational devices that she designed to teach them certain skills and provide them with information and life concepts and to train them on certain behavior, believing that these devices are the best teachers that help train and develop the ability to see, feel and distinguish between things in terms of their size, composition, sound and texture **(Al-Alwan and Abdullah, 2009).**

Ovide Decroly (1871-1932), a Belgian physician, established a school for normal children in Brussels in 1907. Because school is life, at Decroly's school, in order for children to learn how to live, the educational process must be based on self-activity. It is based on observation first, then association and expression. The child observes and evaluates what he observes in the time and place in which he lives, and expresses it tangibly through drawing, making models from clay and paper, and expressing it in language. Self-realization is essential at Decroly's school, and therefore students are divided according to their intelligence, aptitude, and talents. Decroly considers trips, visits to factories, museums, and other places important in the educational process so that children can gain firsthand experience and collect models themselves **(Al-Alwan and Muneeb, 2015).**

Margaret McMillan established her first private kindergarten in Deptford, USA, in 1928 in response to a community need. McMillan described the school of the future as a garden city for children, a small city protected from the elements, each part of which represents a separate unit that meets the needs of children of a specific age group **(Dudek, 2013).**

Educational theorist John Dewey (1859-1952) believed in the importance of direct experience in educating young children. In order for children to learn the path of work and direct experience, they must be provided with a variety of experiences that arouse their interest and align with their inclinations. Dewey's views are important in linking education to life and society, adopting direct experience as a method of work and education, and exploiting the local environment to the maximum extent possible. Farms, parks, museums, factories, social institutions, etc. are laboratories no less important than the school laboratory. Accordingly, field trips are one of the most important aspects of educational activity in the modern Dewey school **(Chandra and Sharma, 2006). Table 2.** Clarifies the most important philosophical and educational ideas promoting kindergarten architecture and the key features of the kindergarten architecture extracted by the current study.

Table 2. The most important philosophical and educational ideas**.**

Educational theorist	Philosophical and educational approach	The key features of the kindergarten architecture
Friedrich Frobel (1782-1852)	Teaching children through free play and interaction with nature **(Al-Sharif, 2014).**	1-Establishing sound modern educational foundations. 2-Focusing on free play and experiential educationa tools. 3-Developing sensory activities such as Froebel's Gifts. 4-Kindergarten is a natural environment for child development, just as plants grow in a garden.
Maria Montessori (1870-1952)	Self-learning through a pre-prepared environment and specialized educational tools **(Al-Alwan and Abdullah, 2009).**	1-Providing a learning environment equipped with interactive tools. 2-Relying on the senses in learning. 3-Encouraging independence and free choice. 4-Reducing teacher intervention and focusing on indirect guidance. 5- Learning through play.
Ovide Decroly (1871-1932)	Learning through self-activity, observation and practical experience **(Al-Alwan and Muneeb, 2015).**	1-Learning is based on observation, association, and expression. 2-Classifying children according to their intelligence and abilities. 3-Enhancing practical experiences through field trips and visits. 4-Developing critical thinking and creativity through direct experimentation.
Margaret McMillan (1860-1931)	Create an educational environment that simulates a garden city to meet the needs of children **(Dudek, 2013).**	1-Designing schools for children as integrated environmental spaces. 2-Enhancing interaction between children and the environment by dividing the school into separate units. 3- Meeting the social, health and academic needs of children
John Dewey (1859-1952)	Education through direct experience and linking knowledge to practical life and society **(Chandra and Sharma, 2006).**	1-Emphasizing spontaneous learning, with the child as the focus, goal, and purpose. 2-Learning through experience and practical application, and self-exploration that fosters critical thinking. 3-Using the local environment as the primary source of learning.

2.4 Indicators for Designing a Stimulating Educational Environment Based on Educational Thought and Learning Styles

Guided by the foundational principles of child-centered education during early years advocated by thinkers like Froebel, Montessori, Decroly, McMillan, and Dewey, as well as the many different learning approaches that support children's growth, a set of architectural indicators has been formulated. The indicators are developed to support the creation of dynamic learning places that contribute to and enhance children's cognitive progress, sensory development, and all-around educational journeys. The child-friendly environments are defined by the blending of natural, supple, and interactive design attributes, turning the architecture into a tool that helps learning and investigation. **Table 3** presents the theoretical

framework highlighting the extracted indicators (from the current study) for designing a stimulating educational environment based on educational thought and learning styles.

Table 3. Theoretical framework: Indicators for designing a stimulating educational environment based on educational thought and learning styles

Educational philosophy (thinkers)	Supported learning style	Architectural indicators
Free play (Friedrich Froebel)	Play-based, sensorimotor learning	Open flexible spaces, outdoor natural playgrounds, and green areas symbolizing the child's natural growth like a plant.
Prepared environment (Maria Montessori)	Active, sensorimotor, cognitive learning	Learning corners classified by activity, child-sized furniture, Interactive learning tools such as digital whiteboards, walls, and tactile floors, organized movement paths enabling independence and free choice.
Observation–association–expression (Ovide Decroly)	Cognitive, active, collaborative learning	Multi-purpose spaces, observation and experimentation areas, workshops for drawing and expression, children's work display areas, and outdoor paths for mini field experiences.
Eco-city vision (Margaret McMillan)	Social, collaborative, active learning	A green environment is divided into small "neighborhoods" or units, with integration of natural elements (trees, hills, shaded areas).
Learning through direct experience (John Dewey)	Social, cognitive, active learning	Realistic learning workshops, outdoor corners inspired by the local environment, children's participation in preparing the environment, and flexible layouts for community interaction.

3. CASE STUDY OF ŠMARTNO TIMESHARE KINDERGARTEN

The Šmartno Timeshare Kindergarten in Slovenia is one of the innovative educational architectural models that use sustainability, an open environment full of activities, and diversity in educational experience, making it a perfect environment for addressing the six different types of learning styles among preschool children. The design does not make extensive use of closed classrooms, but instead makes use of flexible open spaces full of interactive elements that facilitate learning through practice and experimentation.

The sensorimotor learning style is obviously reflected in the design of the multi-use hill, large slide, climbing rope, rubber and grass surfaced walkways, where children engage daily in movement, balance skills and physical coordination, which stimulate and develop the sensorimotor nervous system and physical and mental growth **(Kotnik, 2018),** see **Fig. 1**.

The red slide, which adds an irresistible attraction to play and exercise, children love sliding down it instead of using the stairs. In addition to activities in the outdoor environment **(Kotnik, 2018).** "Play-based learning" philosophy is represented in the large quantity of activity corners (67 corners), the presence of sand boxes, water toys, drawing spaces, and tunnels that make the environment full of free and guided play that develop concepts through experimentation and discovery **(Kotnik, 2018). Fig. 2** shows different play activity areas.

Figure 1. The Šmartno Timeshare Kindergarten in Slovenia.

Figure 2. The different play activity areas **(Kotnik, 2018).**

The open classroom design, lack of solid walls, ease of moving from one place to another, as well as the formation of loose groups of children, characterizes the social and collaborative learning style. It also promotes inter-generational communication with varying teachers, thereby facilitating skills relating to interaction, exchange, and group conversation **(Kotnik, 2018).** The majority of the furniture is flexible and comes with wheels for a fast and effective transformation and different spatial organization of spaces, stimulating children to be active, identify and explore their passions **(Kotnik, 2018). Fig. 3** shows flexible furniture on wheels.

Figure 3. The flexible furniture on wheels creates flexible spaces, allowing for quick and efficient changes and different spatial configurations **(Kotnik, 2018).**

An active learning is represented by the creation of a children's garden with herbs and berries, where children take part in planting and harvest cultivation, giving them notions of responsibility and a certain communion with nature, contributing to environmental awareness impact through everyday operations connected with growing what one **(Kotnik, 2018).** Thus, Šmartno Timeshare Kindergarten presents a complex model of an educational space created based on the current pedagogical principles, where the architectural solutions are combined with the pedagogical concepts to meet the needs of various learning styles in a flexible and inspiring way. The timeshare concept applies not only to the youngsters but also to the local community: the upper hall, which has a separate access for afternoon

activities, is also used as a community center for meetings, seminars, yoga, dance and Pilates lessons **(Architizer, 2025). Table 4.** Shows the application of architectural indicators in Smartno Time Share Kindergarten.

Table 4. The application of architectural indicators in Smartno Time Share Kindergarten

Architectural indicators	Application in Šmartno Kindergarten	Status
Open flexible spaces, outdoor natural playgrounds, green areas symbolizing the child's natural growth like a plant.	Open floor plan merging wardrobes, corridors, stairs with playrooms into one learning landscape (700 m^2). Outdoor playground includes natural surfaces (grass, sand, water), climbing rope, rubber and grass surfaced walkways	Present
Learning corners classified by activity, child-sized furniture, Interactive learning tools such as digital whiteboards, walls, and tactile floors, organized movement paths enabling independence and free choice.	More than 65 activity corners specialized in science, art, music, sports, and play. Child-sized furniture on wheels. Free choice of activities emphasized. No mention of digital whiteboards or tactile floors.	Partially Present
Multi-purpose spaces, observation and experimentation areas, workshops for drawing and expression, children's work display areas, outdoor paths for mini field experiences.	Multi-purpose central area with rainbow stairs, slide, blackboard walls for drawing, and thematic nooks. Outdoor play areas with sand, climbing, water games. No mention of children's work display or scientific observation labs.	Partially Present
Green environment divided into small "neighborhoods" or units, integration of natural elements (trees, hills, shaded areas).	Outdoor playground designed with natural elements (grass, sand, water, multifunctional hill, garden with herbs and berries).	Present
Realistic learning workshops, outdoor corners inspired by the local environment, children's participation in preparing the environment, flexible layouts for community interaction.	The upper hall is shared with the local community for meetings, seminars, and activities (yoga, dance, Pilates), reflecting flexible layouts that promote interaction beyond children.	Present

4. CONCLUSIONS

The research highlights the critical connection between children's perception, learning styles and architectural design of kindergartens. Based on theory, it is demonstrated that perception in early childhood is not a stand-alone mental process, but is well integrated with spatial, sensory, and social experiences. The learning theories highlighted the fact that the process of knowledge construction in children occurs via interaction with the environment, which makes architecture one of the key elements of educational success. The research emphasized the integration of pedagogical concepts with architectural strategies to provide stimulating and supportive learning environments. and to verify the powerful influence of architecture on children's intellectual, social and emotional development.

The findings of this study imply that a functional approach to designing kindergartens is not enough, raising the need for an integrated process that brings together educational concepts, theories of environmental psychology, and architectural innovation. Such an approach

fosters holistic child development, strengthens the link between pedagogy and design, and provides environments that are adaptable, engaging, and future-oriented. Ultimately, this study contributes to bridging the gap between educational concepts and architectural practice by offering measurable design indicators and a tested case study. It demonstrates that architecture can play a transformative role in enhancing children's perception and learning, and it opens pathways for further research to refine these indicators and apply them in diverse cultural and environmental contexts.

Acknowledgements

This work was supported by the Department of Architecture, College of Engineering, University of Baghdad, as part of the M.Sc. research program in Architectural Studies.

Credit Authorship Contribution Statement

Shahad Khalid: Writing and original draft, Literature collection, Data organization, Methodology. Hoda A.S. Al-Alwan: Supervision, Review & editing, Validation, Methodology.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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إدراك الأطفال ومهارات التعلّم: الانعكاسات في عمارة رياض الأطفال

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الخلاصة

تلعب عمارة رياض الأطفال دوراً مهماً في تشكيل إدراك الأطفال وتعلمهم. ومع ذلك، لا تزال العديد من التصاميم تفشل في ترجمة النظريات التعليمية بشكل منهجي إلى حلول مكانية ملموسة. تسلط هذه الفجوة الضوء على مشكلة البحث التي تناولتها الدراسة الحالية وهي غياب المؤشرات المعمارية المتكاملة التي تربط التطور الإدراكي للأطفال وأساليب التعلم والأفكار الفلسفية بتصميم رياض الأطفال. يهدف البحث إلى تطوير مجموعة متسقة من مؤشرات التصميم التي يمكن أن تؤدي إلى التفكير في بيئة تعليمية ملهمة من قبل المهندسين المعماريين وكذلك المعلمين. في المنهجية المتبعة، حددت الدراسة ستة أنواع من أساليب التعلم؛ التعلم المعرفي والاجتماعي والحسي الحركي والتعاوني والنشط والتعلم القائم على اللعب. يلجأ البحث إلى توليفة قائمة على مراجعة الأدبيات لنظريات الإدراك والتعلم مع التركيز على مرحلة الطفولة المبكرة، ودمج العمل الفلسفي والتربوي للمنظرين الذين بدأوا أولاً في استكشاف المفاهيم، وهم فروبل ومونتيسوري وديكرولي وماكميلان وديوي. أدت جميع هذه الاعتبارات النظرية إلى تطوير مجموعة من المؤشرات المعمارية المجردة التي تُعدّ أساساً لتطبيقها العملي في بيئة رياض الأطفال. طُبّقت هذه المؤشرات على روضة سمارتتو لتوضيح كيفية ترجمة المفاهيم المجردة إلى ممارسات معمارية. وخلص البحث إلى أن إخضاع تصميم رياض الأطفال لنظريات الإدراك والتعلم يُعزز فضول الأطفال وإبداعهم ونموهم الشامل، بالإضافة إلى تزويد المهندسين المعماريين أو المصممين بإرشادات عملية لتصميم رياض الأطفال معاصرة تنمي إدراكهم ومهارات تعلمهم.

الكلمات المفتاحية: إدراك الطفل، عمارة رياض الأطفال، مهارات التعلم، التعلم النشط، التطور المعرفي، التفاعل الاجتماعي، التعلم القائم على اللعب.