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Analyzing Cognitive Development in Elementary-Aged Children and Its Implications for Teaching and Learning Strategies

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Abstract: The acceleration and optimization of an individual's development can surpass that of their peers, with disparities emerging from age-related, genetic, dietary, and environmental factors. A profound understanding of human development serves as a crucial foundation for comprehending an individual's needs and character, particularly among elementary-aged children. Defined as those aged 7-12 years or encompassed within the educational system, this demographic necessitates a thorough examination of their cognitive development. Cognitive development constitutes an extensive domain that encompasses various thinking abilities, such as reasoning, memory, problem-solving, ideation, and creativity. Consequently, the present study embarks on a substantive and comprehensive analysis of the cognitive development of elementary-aged children, elucidating its implications for pedagogical practices and learning activities within primary educational institutions (SD/MI). The overarching objective of this research is to ascertain the cognitive development levels of children aged 7-12 and beyond, further exploring the subsequent ramifications on teaching materials, strategies, models, and learning methodologies. The anticipated outcomes of this scholarly inquiry are twofold: to augment the existing body of knowledge accessible to the general public and to provide a valuable resource for educators as they fulfill their pedagogical obligations. By investigating the subject matter through a literary or library research approach, this study engages in data collection and information synthesis derived from various sources housed within libraries.

Keywords: cognitive development, primary school, cognitive aspects, thinking abilities

1. Introduction

Human beings undergo continuous growth and development throughout their lives, commencing from the prenatal phase and culminating at the conclusion of their existence. This study aims to dissect human growth and development into two primary categories: physical and non-physical aspects. The former encompasses height, weight, motor function, and brain development, whereas the latter includes cognitive, socio-emotional, and linguistic development. It is important to note that human physical and non-physical development varies significantly among individuals, with some displaying accelerated or superior development compared to their counterparts. Such disparities may be attributed to factors such as age, genetics, diet, and environment.

A comprehensive understanding of human development is crucial for grasping the needs and character of individuals, particularly those of elementary school age, defined as children aged 7-12 years or those attending primary school. Some scholars emphasized the importance of acquainting parents, teachers, and other caregivers with early childhood development (Lamb & Lewis, 2011; Fredriksen, von Soest, Smith, & Moe, 2019), as these individuals play a pivotal role in shaping children's understanding of positive and negative experiences. Given their reliance on others for fulfilling their needs, elementary school-aged children necessitate special attention from parents, family members, teachers, and their wider social circle.

Elementary school-aged children, due to their limited cognitive maturity, may face challenges in distinguishing between positive and negative experiences and understanding the ramifications of their actions (Mayer, et al., 2014). Cognitive development, a crucial aspect of their growth, comprises a diverse range of thinking skills such as reasoning, memory, problem-solving, creativity, and decision-making (Donelly et al., 2016). These cognitive faculties play a significant role in shaping children's mental, emotional, and linguistic development, as well as influencing their attitudes and behaviors (Donelly et al., 2016). As a result, cognitive development emerges as a cornerstone of non-physical growth.

While substantial research has been conducted on cognitive development in children, there remains a gap in understanding the unique characteristics and constraints of elementary school-aged children's cognitive abilities, particularly in comparison to those of adolescents and adults (Cowan, 2014). Recognizing that their cognitive faculties are generally limited to concrete and tangible concepts, with restricted capacity for abstract reasoning, is crucial for developing targeted educational strategies that cater specifically to this age group (Barac et al., 2014; Figlio et al., 2014).

In light of the aforementioned limitations, it becomes essential to explore the implications of elementary school-aged children's cognitive development in an educational context. To date, existing research has predominantly focused on broad pedagogical approaches without adequately addressing the unique needs of this age group. Consequently, there is a pressing need for novel research that delves into the specific nuances of elementary school-aged children's cognitive abilities, with the aim of informing teaching strategies, methodologies, and evaluation techniques that are tailored to their developmental stage.

Such research would not only fill the existing gap in knowledge but also contribute significantly to enhancing the educational experience of elementary school-aged children. By identifying and addressing the specific cognitive constraints of this age group, educators can develop teaching materials that are better suited to their cognitive abilities, ultimately optimizing learning outcomes (Kempert, Saalbach, & Hardy, 2011; Lundy et al., 2010). Furthermore, this research has the potential to foster a deeper understanding of the relationship between cognitive development and educational success, thereby enabling the creation of more effective and targeted interventions for children at this critical stage of development.

This research endeavor aims to conduct an in-depth and extensive analysis of the cognitive development of elementary school-aged children and its implications for teaching and learning activities in primary educational settings. The study's objectives include determining the cognitive development stages of children aged 7-12 years and exploring the implications of these stages on teaching materials, strategies, models, and learning methodologies. The ultimate goal is to contribute to the existing body of knowledge and serve as a valuable resource for teachers and educators in enhancing the teaching and learning process.

2. Method

In this investigation, a qualitative research methodology was employed to thoroughly explore the naturalistic conditions of the subject matter, with the researcher functioning as the primary instrument. As the focus of this study encompasses literary or library research, the methodological approach necessitated the systematic collection and analysis of data, information, and various other materials available in library resources. Data sources for this research included, but were not limited to, books, academic journals, conference papers, articles, and other pertinent scholarly works, all of which were carefully chosen to ensure their relevance to the subject under examination. The principal theme of this investigation pertained to theories associated with the cognitive development of children in the elementary age group, as well as the implications of these theories for instructional and learning activities. To facilitate data collection, a documentation technique was employed, enabling the researcher to meticulously gather and record pertinent information from the aforementioned sources. Subsequently, the data analysis process was undertaken, with the aim of synthesizing and interpreting the information obtained in order to generate meaningful insights and contribute to the body of knowledge surrounding the cognitive development of elementary age children and their educational experiences.

3. Findings and Discussion

Cognitive development, a critical aspect of human growth, is intrinsically linked to brain development. This encompasses the expansion of the brain in terms of size (volume) and functionality (Gunnell et al., 2019; Mayes et al., 2022; Nigg et al., 1999;). The pace at which an individual's brain develops has a significant impact on their cognitive development. By the age of 10 years, the weight of the brain reaches approximately 95% of the adult brain, in contrast to a mere 25% at birth. This development influences the brain's ability to engage in various cognitive processes, such as comprehension, analysis, synthesis, reasoning, creativity, and action.

Brain development can be divided into two primary components: the left and right hemispheres. The left hemisphere is responsible for rational, scientific, logical, and analytical thinking, including skills related to reading, arithmetic, and language. Conversely, the right hemisphere governs holistic, non-linear, non-verbal, intuitive, imaginative, and creative thinking.

During the elementary years, children's cognitive development progresses through distinct stages, typically between the ages of 7-12 years and beyond. This development occurs in two primary phases: the concrete operational phase (ages 7-11) and the formal operational phase (ages 11-12 and beyond) (Hutton et al., 2020; Gunnell et al., 2019; Mayes et al., 2022). However, it is essential to acknowledge that cognitive development varies among individuals, with some exhibiting rapid progression while others develop more slowly. This variation can be attributed to a multitude of factors, including nutritional intake, genetics, education, and environmental influences. For instance, research has demonstrated that malnourished children exhibit an average IQ score that is 22.6 points lower than their well-nourished counterparts.

Cognitive development plays a vital role in shaping the educational process, as it pertains to learning objectives focused on honing thinking skills (Egger et al., 2019; Hutton et al., 2020; Gunnell et al., 2019; Mayes et al., 2022). This is exemplified in Bloom's Taxonomy of the cognitive domain, a classification system for educational goals. Anderson and Krathwohl's revised version of Bloom's Taxonomy comprises six levels: remembering, understanding, applying, analyzing, evaluating, and creating. These levels serve as a framework for structuring educational experiences that cater to the diverse cognitive developmental stages of elementary-aged children, thereby fostering their intellectual growth in a manner that is both challenging and engaging.

3.1. Cognitive Growth in 7-11-Year-Old Children and Its Impact on Instructional and Educational Practices

Children aged 7-11 years, who have typically entered formal schooling, exhibit cognitive characteristics as described by Piaget's theory of cognitive development. During this stage, known as the concrete operational stage, children's thinking is characterized by an ability to reason logically about tangible, real-world objects and events. Concrete operational thinking signifies a shift from intuitive or instinctive thinking to logical reasoning, provided that such thought processes can be applied to specific, concrete examples.

However, the concrete operational stage also exhibits certain limitations. When confronted with abstract or verbal problems that lack tangible, real-world correlates, children may struggle or even fail to solve them adequately (Nambeye, 2020; Sugianto et al., 2022). While children at this stage can reason logically and comprehend causal relationships, they have not yet developed the capacity for hypothetical or abstract reasoning. Consequently, they can only solve problems that pertain to empirical, sensory experiences, rather than those that require imaginative solutions.

For instance, consider first-grade students presented with a statement about three differently colored glasses—red, black, and white—and asked which glass would appear the brightest and clearest. Lacking the capacity for abstract reasoning, children at this age would likely have difficulty answering the question (Muthukrishnan, 2019; Sajjadian, 2021). Their cognitive limitations preclude them from engaging in scientific and objective reasoning, leading to a range of possible responses. However, if the three colored glasses were physically presented to the child, they would likely be able to answer the question more accurately. During the concrete operational stage, children's cognitive abilities undergo rapid development. Under normal circumstances, the cognitive skills of elementary school-aged children progress gradually. In earlier stages, children's thinking tends to be imaginative, subjective, and egocentric. As they enter formal schooling, their cognitive abilities begin to evolve, shifting towards more concrete and objective reasoning (Hakimi et al., 2019). Egocentrism also diminishes as children develop the capacity to think rationally, enabling them to assess situations from an objective standpoint and logically solve problems. During the concrete operational stage, children exhibit a more advanced understanding of spatial concepts, causation, grouping, inductive and deductive reasoning, conservation, and numerical or mathematical concepts compared to their preoperational counterparts (ages 2-7). These cognitive abilities can be further examined through various sub-concepts.

Firstly, the concept of causation refers to a child's cognitive ability to comprehend the process underlying changes in an observed object. For instance, a child may deduce that when a container, such as a bottle, is filled with water, it becomes heavier (Muthukrishnan, 2019; Sajjadian, 2021). Consequently, the child can infer that the increase in weight is attributable to the water and that all water possesses weight.

Secondly, the concept of grouping encompasses a child's cognitive capacity to categorize objects based on shared or distinct characteristics, such as type, color, or size. The cognitive abilities of elementary children in the concrete operational stage demonstrate relatively sophisticated skills, including seriation, transitive inference, and class inclusion, which progressively develop between early and middle childhood (Nambeye, 2020; Sugianto et al., 2022). Seriation refers to the ability to arrange stimuli or objects based on quantitative dimensions, such as length, color, or weight. For example, when presented with ten pencils of varying lengths arranged haphazardly on a table, children can successfully order them from shortest to longest.

Transitive inference is the capacity to logically combine relationships in order to deduce specific conclusions (Nambeye, 2020; Sugianto et al., 2022). For instance, a child may be shown three balls—red, yellow, and green—where the red ball is the largest, the yellow ball is slightly smaller than the red, and the green ball is slightly smaller than the yellow. Without directly comparing the balls, the child can conclude that the red ball is the largest. Moreover, class inclusion pertains to the ability to perceive the relationship between a whole and its constituent parts. When presented with a bouquet of flowers containing five jasmine stems and three white rose stems, each with numerous petals, a child can correctly assert that there are more petals overall than jasmine flowers. This is in contrast to children in the preoperational stage, who may inaccurately claim that there are more jasmine flowers simply because they are comparing the number of jasmine flowers with the number of white roses.

Thirdly, this investigation examines inductive and deductive reasoning. Inductive reasoning entails the derivation of specific conclusions from a general set of observations, while deductive reasoning operates in the reverse manner (Nambeye, 2020; Sugianto et al., 2022). Piaget posited that children at the concrete operational stage predominantly utilize inductive reasoning, which involves drawing general conclusions about a class based on observations of particular members within that class, such as people, animals, objects, or events. Children who exhibit concrete operational thinking tend to directly engage with a problem when attempting to solve it, in contrast to children who exhibit formal operational thinking (typically aged 11 years and older) (Nambeye, 2020; Sugianto et al., 2022). The latter group initially considers theoretical aspects, proceeds to identify or classify pertinent elements, searches for solutions, and finally tackles the problem. Fourthly, the concept of conservation is explored, which refers to the understanding that the physical characteristics of an inanimate object remain constant even if its form alters. Children at the concrete operational stage are generally capable of comprehending conservation. For instance, in an experiment, a child is presented with two lumps of clay of identical size but different shapes—one elongated and the other round. The child is then asked whether the elongated lump contains more clay than the round one. A majority of children aged 7 or 8 years correctly respond that the size of the clay remains unchanged (Nambeye, 2020; Sugianto et al., 2022). This comprehension of conservation imparts the understanding that an object's dimensions (length, weight, volume, and mass) will not change despite alterations in its shape.

Fifthly, the concept of numerical and mathematical abilities is discussed, encompassing a child's capacity to process numbers through addition, subtraction, multiplication, and division. By the age of 6 or 7 years, many children can perform mental arithmetic (Nambeye, 2020; Sugianto et al., 2022). This numerical proficiency distinguishes itself from other domains, where objects generally require representation. Children's mathematical abilities differ across age levels or grade levels, with higher grade levels exhibiting superior mathematical skills. Piaget's explanation only provides a general illustration of the capabilities children possess when they reach the concrete operational stage. Children's abilities at each age level can differ in terms of reasoning, logical thinking, memory, comprehension, and analysis. These differences serve as the foundation for determining the difficulty of teaching materials, strategies, models, and learning methods in primary education.

Children's cognitive abilities are expected to improve over time, with more advanced or complex material being introduced as they progress through grade levels. Cognitive development can be influenced by various factors, including brain volume, nutrition, education, experience, and environment. However, in the context of cognitive development as a process, experience and environmental factors are the most significant contributors. As stated by Piaget, individuals continuously adapt through their interactions with the environment. This adaptation is a logical consequence of children's engagement in various activities or educational processes, which serve to expand their knowledge and understanding.

3.1.1. Cognitive abilities of Seven Year Olds Students (First-graders)

The cognitive abilities of children at the age of seven are still in the early stages of development, despite having entered the concrete operational phase. According to Bloom's Taxonomy theory, this phase marks the beginning of Level C1 (remembering) and the early stages of Level C2 (understanding), where operational verbs such as compiling, remembering, recognizing, and grouping are utilized. Additionally, children have also begun to enter the lower level of Level C3 (implementing), such as spelling, copying, and asking questions when learning to read (Nambeye, 2020; Sugianto et al., 2022).

It is crucial to note that children's vocabulary should be appropriate for their daily activities and experiences, rather than using scientific or technical terminology (Nambeye, 2020; Sugianto et al., 2022). The spelling method and the synthesis analytical structure (SAS) method are effective learning techniques for Indonesian language acquisition at this stage (Khotimah & Harjono, 2019; Sulaiman & Hasrianti, 2021). The spelling method begins with recognizing the smallest elements (letters), progressing to words and eventually, meaningful sentences . The SAS method involves breaking down a text into sentences and words, and then into syllables (letters) to train children to write letters, words, and simple sentences. Moreover, the introduction of vocabulary should be complemented with empirical objects to enhance children's comprehension and imagination (Sulaiman & Hasrianti, 2021).

Children's mathematical abilities are limited to number recognition, addition, and subtraction in this phase, and multiplication and division operations are not yet within their cognitive abilities (Mutaf-Yıldız et al., 2020; Xie et al., 2020). Teaching and learning methods for mathematics should utilize tools such as manual calculating machines, fingers, detailed pictures, and objects from the surrounding environment. Additionally, children can also be introduced to colors and simple symbols, such as flat shapes and objects from their surroundings. To enhance contextual learning, teaching strategies should link material to real-life situations and everyday life experiences (Mutaf-Yıldız et al., 2020; Xie et al., 2020). Children should also be encouraged to study outdoors to prevent boredom, as their attention span is limited to around 2-3 hours.

In this phase, teachers should design fun and creative learning methods, such as singing, storytelling, and role-playing, as children still require playful and engaging activities. The teacher's role is crucial in educating and intensively teaching children during this period of play.

3.1.2 Cognitive Abilities of Eight Years Old Students (Second Graders)

The cognitive abilities of children in this phase have shown improvement compared to the previous phase. In the context of education, children have progressed to the C2 level of understanding and are transitioning to the C3 stage of implementation, which is a positive development. Operational verbs in this phase include explaining, describing, differentiating, changing, detecting, guessing, classifying, giving examples, and counting (Adelman, 2015; Stanny, 2016). For instance, children are able to read story texts fluently, differentiate between similar colors, and complete tabular worksheets by filling in columns, matching, and completing tasks (Stanny, 2016). Moreover, they are capable of comprehending the contents of a text, such as short stories and fairy tales, and can answer questions related to the text. Furthermore, children can rapidly and accurately group and sort objects by type, size, and color. These findings are consistent with Piaget's research (1952), which indicates that at the age of 7-8 years, children can identify the relationships among objects in a set and arrange them based on size (Adelman, 2015). For example, if given ten sticks of varying lengths, children can sort them from the shortest to the longest. This concept can be applied in teaching and learning activities, such as studying types of animals, fruits, and other objects.

The mathematical abilities of children at this age have also improved, as they can comprehend the different types of sizes, such as weight, length, and volume (Nunes et al., 2012). However, they are not yet capable of changing sizes and can only recognize bar charts. Children can perform multiplication and division but are limited to natural numbers. When presented with questions involving larger numbers, children may experience difficulty. For instance, if they have been taught multiplication of numbers below 10, they may struggle with answering questions involving two-digit numbers. Children cannot perform multiplication and division with decimal numbers and numbers reaching into the thousands (Nath & Szücs, 2014).

Nature-based learning, which involves learning in an open natural environment, is highly relevant to this phase, as it helps children stay engaged and prevents boredom. To facilitate easier comprehension of material, teachers should provide real-life examples and conduct experiments (Nath & Szücs, 2014). Children at this age can focus on learning for approximately 2-3 hours, after which they may feel tired, sleepy, and seek play activities. Although children can learn with formal nuances, they still require fun learning activities such as game-based learning.

3.1.3 Cognitive Abilities of Nine Years Old Students (Third Graders)

In this phase, cognitive abilities increase significantly. Children become capable of solving more complex problems due to their accumulated knowledge, insight, and experience from previous developmental stages. They enter a higher cognitive realm, specifically the realm of application (C3) (Rahayu, 2018). The ability to apply involves utilizing previously learned material in new situations and employing rules and principles. Key verbs associated with this phase include choosing, changing, calculating, demonstrating, modifying, predicting, generating, connecting, showing, and practicing (Khaldun, 2020).

In contrast to the previous stage, where children primarily engaged with everyday objects, they can now think more deeply and imagine abstract concepts. For example, they can be introduced to the solar system, learning about planets, comets, and stars through visual or audio-visual materials. Children begin to understand cause-and-effect relationships and can identify solutions to problems, although they may still require assistance from teachers or peers (Hutton et al., 2020; Mayer et al., 2014; Sugianto, Darmayanti,

& Vidyastuti, 2022). Mathematical skills improve during this phase as well. Children not only recognize various types of flat shapes but can also calculate their areas and identify geometric shapes. They can understand processes that change shapes, such as transforming a square into two triangles or parallelograms (Hutton et al., 2020; Mayer et al., 2014; Sugianto, Darmayanti, & Vidyastuti, 2022). Mental calculations become easier, allowing children to perform arithmetic without manually counting or writing. For instance, they can spontaneously answer questions about multiplying single-digit numbers but may need manual calculations for more complex problems, such as multiplying larger numbers.

At this stage, learning systems incorporating group discussions can be effective, but they require attentive guidance from teachers. Since children's discussion skills are still limited, their ability to think and work collaboratively needs further development. Additionally, their focus may easily waver, necessitating intensive control, supervision, and guidance during the learning process. By the age of 8-9 years, children can typically concentrate on learning activities for 3-4 hours per day.

3.1.3 Cognitive Abilities of Ten Years Old Students (Fourth Graders)

In this developmental phase, children exhibit improved critical thinking abilities, allowing them to examine problems in depth and from various perspectives. Their cognitive abilities within the C3 realm (applying) are significantly enhanced compared to earlier stages, enabling them not only to count and exchange objects but also to make comparisons between them. By the age of 9-10 years, children reach the C4 level (analyze), which is defined as the ability to dissect or describe a subject or situation according to its smaller components and understand the relationships among these parts or factors(Hutton et al., 2020; Mayer et al., 2014; Sugianto, Darmayanti, & Vidyastuti, 2022). At this stage, children can analyze, contrast, and connect theories with facts to draw conclusions. They are also capable of justifying their claims with scientific reasoning.

The author's teaching experience reveals that, during this phase, children can analyze texts to gain new knowledge and understanding, discerning positive and negative values within the content. They can be introduced to historical topics (religion, empires, colonial era, etc.). Essentially, by the age of 10, children enter the realm of synthesis (C5), albeit at a rudimentary level, such as being able to logically categorize and combine various objects (Hutton et al., 2020; Mayer et al., 2014; Sugianto, Darmayanti, & Vidyastuti, 2022). In science learning, they can study intangible subjects like air and gas, and comprehend changes in the form of objects. Their mathematical skills advance as well, allowing them to tackle more complex problems, such as operating with fractions and decimals, calculating the area of a flat shape, determining the volume of geometric shapes, and converting units of measurement (e.g., kilograms to grams, centimeters to meters). They can also apply multiplication and division to solve narrative or story-based problems.

During this phase, children are capable of participating in cooperative learning systems, wherein they learn and work collaboratively in small groups. One suitable cooperative learning model for this stage is Student-Teams-Achievement Divisions (STAD) (Yusuf, Natsir, & Hanum, 2015. The STAD cooperative learning method utilizes small groups of 4-5 children, each assigned a task to discuss before proceeding to a quiz or question-and-answer session. This learning model fosters communication, idea exchange, and collaborative problem-solving among children, encouraging them to think critically about previously unfamiliar subjects.

3.2. Cognitive Growth in 11-12-Year-Old Children and Its Impact on Instructional and Educational Practices

At an earlier age, children can think logically and systematically about empirical objects, which are tangible and can be captured by the senses. In contrast, children aged 11-12 years and older can consider hypothetical situations and abstract concepts. This stage is referred to as the formal operational phase, which is the final stage in cognitive development according to Piaget. Ginsburg and Opper (1988) suggest that, at this stage, children can think flexibly and effectively, as well as handle complex problems. For instance, children can reason about abstract relationships, such as when asked: If Joe is shorter than Bob, and Joe is taller than Alex, who is the tallest among them? The child can answer correctly without having the individuals present, unlike in the concrete operational phase where a real object representation is necessary.

During the formal operational phase, children employ hypothetical-deductive thinking, developing optimal hypotheses or predictions and systematically planning strategic steps to solve problems (Ding, 2018). This thought process necessitates higher-level thinking patterns, including understanding individual variables and the relationships between them. The hypothetical-deductive learning cycle model is particularly effective for fostering critical thinking and enhancing conceptual understanding in children.

In the educational context, children in this phase typically attend fifth and sixth grade levels. By the age of 11 (fifth grade), children's cognitive abilities advance to evaluation (C5) and creation (C6), and further improve at age 12 and above (sixth grade). Children in this phase can think critically, identifying cause and effect before devising problem-solving strategies. They perceive objects from multiple dimensions, such as understanding various aspects of electricity beyond merely illuminating light bulbs. Their memory strengthens, enabling strategic thinking, as evidenced by expert child chess players outperforming beginners in recalling chess piece information (Ding, 2018). Children's mathematical abilities also become more complex, progressing from calculating the area of flat shapes to determining area, perimeter, and volume of geometric shapes (Pina et al., 2014).

During this phase, student-centered learning models, such as the Inquiry learning model, can be applied. Inquiry learning is an observational, experiential learning pattern. Studies show that the scientific attitude of fifth graders significantly improves when the inquiry learning model is employed. These results suggest that children aged 11 can engage with learning models that require high-level thinking and critical thinking skills. Moreover, they can utilize cooperative, inquiry, or constructivist learning methods (Kempert, Saalbach, & Hardy, 2011; Lundy et al., 2010).

Constructivist learning is a philosophy based on the paradigm that knowledge formation in individuals is not solely a result of knowledge transfer, but a product of mental activity supported by experiential processes to build individual understanding. A study found that the constructivist learning model enhanced learning outcomes and engagement for sixth-grade students at SD 6 BPK Penabur Bandung. This method aligns with Piaget's view that knowledge is constructed by students interacting with their environment or objects they study, a concept known as operative learning (Kempert, Saalbach, & Hardy, 2011; Lundy et al., 2010). The author posits that the constructivist learning model may not be suitable for all age levels or children with lower cognitive domains, as it demands high-level thinking to interpret novel and abstract concepts. Furthermore, children in this phase possess the ability to make informed decisions based on scientific principles, create innovations using prior knowledge, and produce literary works or art. In terms of mathematical ability, they can develop mind maps and devise their own problem-solving methods (Kempert, Saalbach, & Hardy, 2011; Lundy et al., 2010).

4. Conclusion

Cognitive development in elementary-aged children is a crucial aspect of the educational process, particularly in teaching and learning activities. The cognitive abilities of children in this age range can vary significantly, and understanding these differences is essential for educators. According to Piaget's cognitive development theory, children's cognitive abilities can be divided into two stages during their elementary years. The first stage, known as the concrete operational phase (ages 7-11), is when children develop the capacity for logical, rational, scientific, and objective thinking about concrete or real-world situations. In this phase, teachers should focus on providing learning materials that are empirical and tangible, rather than abstract or theoretical. The teaching and learning process should be contextualized in real-life situations, using direct examples of the material being studied (modeling) and hands-on practice (experiments). The second stage, the formal operational phase (ages 11-12 and beyond), is characterized by the ability to think hypothetically, consider potential outcomes, and engage with abstract concepts. At this stage, children develop critical thinking skills and higher-level cognitive abilities. They become capable of using hypothetical-deductive and systematic thinking to devise strategic solutions to problems. In the teaching and learning process, children at this stage can benefit from constructivist and inquiry-based learning models, which emphasize high-level reasoning and active engagement in generating ideas and drawing meaning from both empirical and abstract concepts. Recognizing the importance of understanding each level of a child's cognitive abilities is crucial in guiding the educational process. Effective teaching and learning activities are dependent on aligning the materials, strategies, models, and methods with the cognitive abilities of the students. By doing so, children can gain maximum knowledge, setting the foundation for their lifelong learning and growth.

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