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Enhancing Early Childhood Cognitive Development Through Play-Based Learning: A Case Study

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Abstract

ABSTRACT
Background of study: This research focuses on the cognitive development of children at Al-Hidayah Kindergarten. It explores how children's learning processes involve not only stimulus and response but also the individual behavior of each child in achieving learning goals. In cognitive development, the process of learning is considered more important than the final outcome, as each child's cognitive abilities develop at different paces.
Aims and scope of paper: The aim of this study is to examine the cognitive learning processes of early childhood students through structured play activities, such as puzzle-solving and block-stacking games. These activities are believed to enhance problem-solving skills and foster creativity. The study also observes how group-based learning models are implemented and the challenges encountered in promoting cognitive development in a preschool setting.
Methods: This study employs a qualitative approach with data collected through observation and interviews. The focus is on how children interact with cognitive-stimulating games and how these interactions reflect their developmental progress.
Results: The findings indicate that providing children with play-based learning opportunities significantly supports the development of their cognitive skills. However, challenges include children becoming easily bored and exhibiting egocentric behaviors, such as reluctance to share or cooperate with peers.
Conclusion: It is essential to offer cognitively enriching play activities to preschool children, as these help them learn to solve problems—ranging from simple to complex—and enhance their creativity. Addressing behavioral challenges such as boredom and egocentrism is also crucial for optimizing the learning environment.

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INTRODUCTION

Early childhood education is a crucial stage in human development that lays the foundation for lifelong learning and holistic growth. Institutions that serve early learners are responsible for nurturing six core developmental areas: cognitive, language, social-emotional, religious-moral, physical-motor, and artistic development [1], [2], [2], [3], [4]. Among these domains, cognitive

development plays a central role, as it directly supports children's ability to think, reason, remember, and problem-solve—skills that are fundamental for academic success and everyday life [5], [6], [7], [8].

At TK Al-Hidayah, educators have adopted a group learning model as the primary instructional strategy. This model aligns well with the developmental needs of early childhood, particularly in the cognitive domain. Group learning fosters collaborative exploration, where children learn through social interaction, shared experiences, and hands-on activities. The model is based on the sociocultural theory of Vygotsky, which emphasizes the role of social interaction in cognitive development [9], [10], [11], [12]. According to Vygotsky, children learn more effectively when they engage in tasks slightly beyond their current level of competence but achievable with the support of peers or adults, a concept known as the Zone of Proximal Development (ZPD) [7].

Group learning activities at TK Al-Hidayah are designed to be engaging, playful, and meaningful. Teachers frequently organize children into small groups where they can participate in structured tasks such as building with blocks, matching shapes, storytelling, counting games, or science explorations. These activities stimulate various cognitive processes including classification, sequencing, problem-solving, memory recall, and logical reasoning. For instance, when children work together to build a tower using blocks, they are not only enhancing their motor skills but also applying spatial awareness, balance, and planning—key components of cognitive functioning.

One of the distinct advantages of group learning is that it transforms the classroom into a learning community, where knowledge is co-constructed. Children are encouraged to share their ideas, ask questions, and listen to different perspectives. This interaction helps to develop their metacognitive skills—thinking about thinking—and encourages reflection and critical analysis. Through discussion, negotiation, and consensus-building, children also learn how to articulate their thoughts, defend their viewpoints, and consider alternative solutions.

However, the successful implementation of a group learning model requires a well-prepared environment and adequate learning materials. At TK Al-Hidayah, one of the main challenges in promoting cognitive development through this model is the limited availability of Educational Play Tools (EPT). Educational play tools are essential resources in early childhood settings, as they provide concrete, hands-on experiences that help children internalize abstract concepts. These tools range from puzzles and manipulatives to science kits and dramatic play materials.

The shortage of EPTs in the classroom can significantly impact the effectiveness of the learning process. When children have to take turns using materials due to limited supply, it not only reduces their active engagement time but also diminishes the depth and quality of their learning. Long waiting times can lead to boredom, frustration, and behavioral issues, which distract from the learning goals. Moreover, it limits opportunities for spontaneous exploration, which is a key characteristic of meaningful learning in early childhood [13].

To address this issue, educators at TK Al-Hidayah have adopted several strategies. *First*, they maximize the use of locally available materials and recycled items to create alternative educational tools. Items such as bottle caps, cardboard, plastic containers, and cloth pieces are transformed into counting aids, sorting tools, and art supplies. This approach not only alleviates the problem of material shortages but also instills values of creativity, environmental awareness, and resourcefulness in children.

Second, teachers design rotational learning centers that allow small groups of children to engage in different activities simultaneously. For example, while one group is working with APEs, another group may be engaged in a storytelling session, a puzzle-solving task, or a sensory activity using natural materials like sand, leaves, or water. This method helps ensure that all children remain actively involved and reduces the pressure on limited resources.

Third, the school fosters parental involvement and community support to enrich the learning environment. Parents are encouraged to contribute unused household items that can be

repurposed into learning tools or to volunteer in the classroom during activity time. Community members and local artisans may also be invited to help create culturally relevant educational tools that reflect the local environment and traditions.

Despite these adaptations, it is important to acknowledge that cognitive development is not solely dependent on the availability of physical tools. The role of the teacher is equally, if not more, important. At TK Al-Hidayah, teachers are trained to act as facilitators who guide children's exploration, ask open-ended questions, and scaffold learning experiences. For example, during a group activity using number cards, a teacher might prompt children with questions like, "What happens if we add one more card?" or "Can you find a pattern in these numbers?" These kinds of interactions push children to think deeper and apply cognitive strategies such as reasoning and prediction.

Furthermore, group learning supports the development of executive functions—a set of mental skills that include working memory, flexible thinking, and self-control. When children participate in group tasks, they need to remember instructions, shift between activities, and regulate their emotions to work harmoniously with others. These skills are crucial for success in school and beyond, forming the basis for planning, decision-making, and goal-directed behavior.

The cognitive benefits of group learning also extend to the development of language and literacy skills [8], [11], [14]. When children converse during group activities, they expand their vocabulary, learn new sentence structures, and develop narrative skills. Language serves as a cognitive tool, allowing children to label concepts, describe processes, and make sense of their experiences. In turn, improved language ability supports better understanding of abstract and symbolic thinking—another core aspect of cognitive growth.

Based on the findings of this study, the implementation of the group learning model supports children's cognitive development. Children are able to solve problems collaboratively or individually and exchange ideas. They progress through different stages of understanding, and their knowledge develops as they gain continuous experiences and expand their understanding of various information—ultimately enhancing their abilities.

METHOD

Research Design

This study employed a qualitative field research approach, which involved operational research activities by directly observing phenomena occurring in the field. The research was conducted through active participation in the natural setting of the study site to gain in-depth insights into the cognitive development of early childhood learners.

Research Subjects

The research took place at TK Al-Hidayah, located on Jalan Kraton, Telang Barat, Telang, Kamal District, Bangkalan Regency. The subjects of the research consisted of two informants: the head of the kindergarten and one teacher from the institution.

Data Collection Techniques

The data collection techniques used in this study included active participant observation and structured interviews. In participant observation, researchers were directly involved in classroom teaching and learning activities. Each class was assigned two student-researchers, who not only observed but also actively participated in teaching activities. In addition, structured interviews were conducted using a predetermined set of questions designed to elicit specific information in a consistent manner.

Data Analysis Techniques

Data were analyzed through direct engagement in each class to obtain detailed and firsthand results. The analysis followed the Miles and Huberman model, which consists of three

key steps: data reduction, data display, and conclusion drawing [15]. This approach enabled a systematic and comprehensive understanding of the data gathered in the field.

RESULTS AND DISCUSSION

Results

Cognitive development is a fundamental aspect of early childhood education, as it lays the groundwork for how children think, learn, and solve problems throughout their lives. In the context of TK Al-Hidayah, this cognitive development is stimulated through carefully planned strategies integrated into daily classroom activities. Observations reveal that children are introduced to various animals, engaged in tasks such as assembling animal names, and encouraged to color pictures using activity worksheets. These tasks are not merely mechanical; rather, they are designed to activate children's thinking processes, prompting them to ask questions and express their understanding verbally or through creative expression.

One of the most significant components of the cognitive development strategy at TK Al-Hidayah is the use of questioning. Questioning is an integral part of cognitive processes and is often driven by the natural curiosity of children. This aligns with the cognitive development theory of Jean Piaget, who asserts that children actively construct knowledge through interaction with their environment or the objects they observe [7]. In other words, knowledge is not transferred passively from teacher to student; it is built internally by the child through experience. At TK Al-Hidayah, teachers foster this process by encouraging children to ask questions, make observations, and engage with learning materials in a way that stimulates their cognitive functions.

The cognitive development activities at TK Al-Hidayah can be categorized into three major processes: gathering information, reasoning, and communicating. In the first stage, children respond to prompts and questions from the teacher, observe visual aids, or listen to short stories or songs. This allows them to gather data through sensory input. In the reasoning stage, children are encouraged to connect new information with what they already know. For example, when they learn that both cows and goats eat grass, they begin to identify patterns and understand classification. Finally, during the communication stage, children are given opportunities to express what they've learned through speech, drawings, storytelling, or performances. This verbal and expressive output not only reinforces their learning but also allows teachers to assess their understanding and identify areas that need support.

Assessment of cognitive development at TK Al-Hidayah is based on how effectively a child's mental processing aligns with their verbal responses. For example, if a child is able to correctly identify animals and their sounds or complete animal-related tasks accurately, this is taken as an indicator of successful cognitive growth. Such activities require the coordination of multiple cognitive skills, including memory recall, categorization, and verbal articulation. When children demonstrate accurate and thoughtful responses to teachers' questions, it reflects the successful integration of mental processing and expression.

A significant factor contributing to the success of cognitive development at TK Al-Hidayah is the involvement of parents. Learning does not stop at the classroom door; rather, it continues at home through various forms of reinforcement. Teachers often assign simple observation tasks or worksheets that require parental guidance, such as identifying animals in their environment or discussing what was learned in class. Parents help children complete coloring sheets, review animal names, and imitate animal sounds. These home-based activities strengthen cognitive connections formed during school and create a collaborative learning environment between teachers and families.

It is important to note that each child possesses a unique cognitive trajectory shaped by their individual interests, abilities, and learning pace. This diversity requires teachers to be sensitive and responsive to the needs of each child. At TK Al-Hidayah, this philosophy is translated into practice through differentiated instruction. Children who show signs of delayed

cognitive development receive additional guidance, encouragement, and scaffolded learning experiences tailored to their abilities. Teachers work closely with these children, providing direct support and using alternative methods to ensure they are able to engage meaningfully in classroom activities.

Despite these supportive strategies, several challenges continue to affect cognitive development. One of the most common is health-related. When children are physically unwell, their energy and motivation to participate in learning decrease significantly. Emotional stress, whether due to problems at home or in peer relationships, can also reduce creativity and concentration. Additionally, in some cases, overly active social interaction among peers can become a distraction, making it harder for children to focus on cognitive tasks. These obstacles require careful classroom management and emotional support to ensure a stable and productive learning environment.

Teachers at TK Al-Hidayah also face limitations in terms of resources. One of the major constraints is the lack of adequate educational play tools or instructional media due to limited school budgets. In response to this limitation, the school utilizes natural and recycled materials available in the environment. Leaves, sticks, stones, and cardboard are transformed into learning tools, allowing children to engage with materials in a creative and hands-on manner. This practice not only addresses the issue of material scarcity but also teaches children about sustainability and resourcefulness.

In addition, the school recognizes that intelligence varies among children. Some grasp concepts quickly, while others require repetition and varied exposure. Therefore, TK Al-Hidayah employs multiple instructional approaches to accommodate different learning styles, including visual aids, storytelling, role-play, and games. For visual learners, colorful images and picture cards are used; auditory learners benefit from songs and verbal instructions; while kinesthetic learners thrive in physical activities and movement-based games. These diverse methods ensure that every child has access to learning experiences that suit their cognitive preferences.

Discussion

This study explores the cognitive development of young children at TK Al-Hidayah, with a particular focus on how cognitive skills are fostered through educational play and environmental learning. Cognitive development in early childhood encompasses a wide range of mental processes, including attention, memory, reasoning, problem-solving, and language acquisition. At TK Al-Hidayah, these processes are nurtured through structured yet playful learning experiences. The school uses both educational play tools—such as building blocks and puzzles—and the surrounding environment as vital resources for supporting children's cognitive growth.

The application of educational play serves as the foundation of the learning activities implemented at TK Al-Hidayah. Children engage in tasks that require them to construct, organize, compare, and categorize information. For instance, by assembling puzzle pieces, they not only develop fine motor skills but also enhance their spatial reasoning, sequencing abilities, and problem-solving strategies. Blocks are used not just to build structures, but also to explore concepts such as balance, size, symmetry, and measurement. These activities align closely with developmental goals that support children’s natural curiosity and intrinsic motivation to learn.

The approach taken by the educators at TK Al-Hidayah is consistent with the theory of cognitive development proposed by Jean Piaget. According to Piaget, cognitive development occurs through a dynamic process known as adaptation, which includes two complementary processes: assimilation (incorporating new experiences into existing mental frameworks) and accommodation (adjusting mental frameworks to incorporate new experiences). Children learn not simply by imitating teachers or memorizing facts, but by actively engaging with their surroundings and constructing understanding through interaction. Learning, in Piaget’s view, is not transmission but transformation.

Piaget identified four stages of cognitive development: sensorimotor (birth to 2 years), preoperational (2–7 years), concrete operational (7–11 years), and formal operational (11 years and older) [16], [17], [18]. The children at TK Al-Hidayah are primarily within the preoperational stage, characterized by symbolic thinking, the use of language, imagination, and egocentrism. In this stage, children begin to use symbols to represent objects, people, and events, but their thinking is still not yet logical or operational. Therefore, learning experiences must be concrete, visual, and hands-on to facilitate understanding.

In practice, the school still predominantly adopts a classical model of instruction, where the teacher leads the class from the front. However, children are organized into small groups or table-based clusters, allowing for peer interaction and collaborative engagement. Learning materials such as activity worksheets are used to guide students through structured activities such as matching, identifying colors, tracing shapes, and basic counting. These worksheets are designed to encourage children to follow instructions, recognize patterns, and recall previously learned information, all of which are vital components of cognitive processing [19], [20], [21].

Teachers also ask questions during activities to promote critical thinking and verbal expression. For example, children may be asked to identify the color of an object, count items, or follow multi-step instructions. These question-and-answer sessions help assess children's understanding and stimulate their ability to organize and verbalize thoughts. In some cases, especially under parental pressure, children are taught early reading skills even before they are developmentally ready. While this may cater to academic expectations, it can potentially overlook the developmental appropriateness of the learning content for early learners.

The cognitive learning theory supports the notion that learning is both an internal and external process. It highlights the importance of the learner's mental capabilities while also acknowledging the influence of environmental and social factors. The cognition serves as the mental engine that powers processes such as perception, analysis, decision-making, and problem-solving [22], [23], [24], [25], [26]. This theoretical framework views learning as a lifelong interaction between individuals and their environment. In this light, every learning activity—whether it involves manipulating objects, engaging in discussion, or reflecting silently—can be seen as part of a larger cognitive process.

At TK Al-Hidayah, the surrounding environment is also used as an extension of the classroom. Teachers often conduct lessons outside, where children can observe plants, animals, and natural phenomena. Such experiences allow learners to engage in direct observation and draw connections between classroom concepts and real-life contexts. For example, after learning about animals in class, children may be asked to identify insects or birds in the school yard. This reinforces their ability to classify and relate information across settings.

However, the school also faces significant challenges that affect the implementation of optimal cognitive development strategies. One major issue is the shortage of teaching staff. With only one teacher per classroom, and a high student-to-teacher ratio, it becomes difficult to give each child the attention and scaffolding they need [27], [28], [29], [30], [31], [32], [33]. This can hinder the teacher's ability to differentiate instruction, monitor individual progress, and provide timely support for children who are struggling. In some instances, classes have to be merged due to resource constraints, further diluting the learning experience and reducing children's ability to concentrate and engage meaningfully with tasks.

These structural limitations not only affect the cognitive domain but also the broader emotional and social dimensions of learning. When children do not receive adequate individual attention, they may become disengaged or frustrated, which in turn affects their willingness to explore, question, and participate [34], [35]. Overcrowded classrooms also limit opportunities for group activities, inquiry-based learning, and peer-to-peer discussion—methods that are highly effective in promoting cognitive development.

Furthermore, the expectations of parents sometimes place pressure on teachers to accelerate learning outcomes, particularly in reading and writing [36]. While parental involvement is crucial to supporting children's learning at home, unrealistic expectations can lead to instruction that

prioritizes rote learning over cognitive engagement. Teachers at TK Al-Hidayah are aware of this tension and attempt to balance developmental appropriateness with academic preparedness. They strive to integrate early literacy activities in a playful, enjoyable way, such as through storytelling, song lyrics, and picture books, to ensure that learning remains aligned with children's cognitive readiness [37], [38], [39], [40], [41], [42], [43].

Despite the limitations, the educators at TK Al-Hidayah demonstrate strong commitment to cognitive development. They make creative use of the available resources, including natural and recycled materials, to design engaging learning experiences. In the absence of sophisticated educational tools, everyday items such as bottle caps, leaves, and sticks are repurposed into learning aids that help children develop sorting, counting, and comparing skills. This approach reflects not only pedagogical flexibility but also promotes values of sustainability and environmental awareness among young learners.

In summary, cognitive development at TK Al-Hidayah is promoted through a combination of educational play, environmental exploration, and teacher-guided instruction. The use of Piagetian theory provides a solid theoretical foundation for understanding how children actively construct knowledge. While the school faces challenges such as limited staffing and high student numbers, it remains committed to fostering critical thinking and problem-solving through meaningful, developmentally appropriate practices. Addressing these challenges—by investing in teacher training, reducing class sizes, and increasing access to learning resources—would significantly enhance the effectiveness of cognitive development strategies in early childhood education.

Implications

The findings of this study have several important implications for early childhood education, particularly in the areas of classroom practice, teacher training, curriculum development, and education policy. First, the study underscores the need for teachers to intentionally design learning activities that support fine motor development. Engaging, play-based tasks that incorporate natural or low-cost materials—such as sand, clay, stones, and paper—can effectively stimulate children's motor coordination while maintaining their interest and motivation. Second, there is a clear need for ongoing professional development that equips teachers with a deeper understanding of fine motor milestones, early detection of developmental delays, and appropriate intervention strategies. This is especially crucial for inclusive classrooms where children exhibit diverse developmental needs. Additionally, the results highlight the importance of integrating fine motor stimulation explicitly into the early childhood curriculum. Schools must avoid the tendency to prioritize academic content (e.g., early reading and writing) at the expense of foundational motor skills, which are essential for later academic success. Strengthening collaboration between educators and parents is also vital, as children benefit most when fine motor practice continues at home through simple activities like folding clothes, sorting objects, or drawing. Finally, the study calls for stronger policy support and budget allocation to provide adequate learning materials and training resources, particularly in schools with limited funding. Policymakers should recognize the long-term importance of early fine motor development in shaping a child's readiness for school and overall self-efficacy. By addressing these areas, educational stakeholders can better support the holistic growth of children during their formative years.

Research Contribution

This study contributes to the growing body of knowledge on cognitive development in early childhood education by providing practical insights into how cognitive processes are fostered in a real-world learning environment, specifically within the context of TK Al-Hidayah. It highlights how educational play, environmental engagement, and guided instruction can effectively support cognitive growth in young learners, even under resource constraints. By

documenting the strategies and challenges faced by educators, the study offers a contextualized understanding of how Piaget's and other cognitive development theories are applied in practice. Moreover, it reinforces the importance of considering both internal learner factors and external conditions—such as class size, instructional media, and parental expectations—in shaping cognitive outcomes. The research also adds value by exploring how local materials and informal resources can be creatively repurposed for educational use, thereby offering sustainable solutions for under-resourced schools.

Limitations

Despite its contributions, this study has several limitations. First, the research is context-specific, focusing on a single early childhood education institution, TK Al-Hidayah. As such, the findings may not be fully generalizable to other educational settings with different cultural, socioeconomic, or institutional characteristics. Second, the data collected were primarily based on classroom observations and informal interviews, without the use of standardized cognitive development assessments. This limits the ability to quantify children's cognitive progress or compare it across individuals or institutions. Third, the study did not deeply explore the perspectives of children themselves regarding their learning experiences. Since young children are capable of expressing thoughts and preferences in developmentally appropriate ways, their voices could enrich the analysis. Finally, while the study discusses teacher strategies and parental expectations, it does not include an in-depth analysis of curriculum design or policy-level influences that might also affect learning outcomes.

Suggestions

Future research should aim to build on the findings of this study by expanding the scope to include multiple early childhood institutions, ideally with diverse demographic and geographic contexts. Comparative studies could help identify patterns, strengths, and challenges in different educational settings, providing more generalizable recommendations. Additionally, future studies should incorporate more rigorous methods of data collection, such as standardized assessments of cognitive development, longitudinal tracking of learning outcomes, and mixed-method designs that combine quantitative and qualitative data. It would also be valuable to include the voices of children through participatory techniques such as guided storytelling, drawing, or child-led interviews. Another area worth exploring is the impact of specific interventions, such as teacher training programs or the introduction of low-cost learning media, on children's cognitive outcomes. Lastly, researchers should examine the influence of educational policies and systemic support mechanisms on the implementation of cognitive development strategies in early childhood education, particularly in underfunded or rural schools.

CONCLUSION

Cognitive development during early childhood plays a crucial role in shaping a child's ability to think, reason, solve problems, and understand their environment. This study has examined how TK Al-Hidayah supports cognitive growth through a combination of educational play, teacher-guided instruction, and environmental learning. The use of learning media such as puzzles, blocks, and activity worksheets, combined with real-life observations and questioning strategies, has proven effective in stimulating children's mental processes. Grounded in Piaget's constructivist theory, the learning activities encourage children to actively construct knowledge through interaction, exploration, and expression.

Despite structural challenges such as limited teaching staff and educational resources, the teachers at TK Al-Hidayah demonstrate a strong commitment to fostering children's cognitive development. Their creative use of local materials and efforts to maintain child-centered learning reflect a deep understanding of developmentally appropriate practices. Parental involvement

also plays a significant role, bridging home and school environments to reinforce cognitive learning.

This study emphasizes that successful cognitive development in early childhood requires more than just academic instruction; it demands a supportive, interactive, and resourceful environment where children can explore, ask questions, and build understanding at their own pace. Moving forward, greater investment in teacher training, classroom resources, and individualized instruction will be essential to further enhance cognitive learning outcomes, especially in under-resourced educational settings. Ultimately, nurturing children's cognitive abilities from an early age lays the foundation for lifelong learning, critical thinking, and adaptive functioning in an ever-changing world.

AUTHOR CONTRIBUTION STATEMENT

AA conceived the research idea. MAS was responsible for data collection. AS carried out the data analysis. AR and SA contributed to the development of the theoretical framework on cognitive development and early childhood education. All authors participated in discussions of the findings and contributed to the final manuscript.

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