

The Impact of the Drill and Practice Learning Model on the Cognitive Development of Students in the Concrete Operational Stage

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ABSTRACT

Addition is a fundamental arithmetic concept that is abstract for students still in the concrete operational stage of cognitive development. To address this, an appropriate instructional model was selected to facilitate student understanding; specifically, the teacher chose a "drill and practice" model to allow students to explore their grasp of addition. However, challenges arose during the process, given that the students were in a transitional phase between the preoperational and concrete operational stages. This study examines the phenomena observed in the cognitive development of students in the concrete operational stage resulting from the implementation of the drill and practice model. Data collection involved interview and classroom observation. The study yielded both positive and negative findings regarding the students' cognitive development. Implementing the "Drill and Practice" model helps teachers address student learning challenges during the early concrete operational stage through intensive practice and repetition; however, its implementation still faces obstacles, specifically a poor understanding of addition concepts, a tendency among students to rely on rote memorization, and a lack of student-to-student interaction, which lead to confusion and a classroom atmosphere that is less than conducive to learning.

Keywords: Drill and Practice, Cognitive Development, Concrete Operations

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INTRODUCTION

Learning addition is an important foundation for students' subsequent mathematical development. However, students at the concrete operational stage may still experience difficulties in understanding and performing addition, particularly when mathematical operations are presented in abstract forms or without sufficient concrete experiences and repeated practice. These difficulties are related to the characteristics of cognitive development at this stage, in which students begin to develop logical thinking but still rely on concrete objects or representations when understanding mathematical concepts. Therefore, addressing students' difficulties in learning addition is important because inadequate understanding of basic arithmetic operations may affect their ability to develop more complex mathematical skills. Education serves as a means to develop one's personal potential through the learning process (Fitri, 2021). It enhances various aspects of knowledge, namely cognitive, affective, and psychomotor. The cognitive aspect is paramount, as success in developing it can determine success in other areas (Juwantara, 2019). Cognitive development also plays a significant role in improving thinking skills; robust cognitive development enables students to maximize their potential.

Cognitive development varies from student to student, depending on the treatment or

educational approach they receive. Regarding school-based experiences, the cognitive development that takes place is linked to the students' learning history. Student learning activities are influenced by several factors, including the environment (specifically peers), facilities and infrastructure, and the teachers themselves. Consequently, teachers play a crucial role in fostering students' cognitive development. A child's cognitive development aligns with their current developmental stage. Therefore, how teachers approach students to help them develop their potential, such as through the selection of appropriate learning models, is vital. In mathematics learning, this issue is particularly relevant to the understanding of addition, which requires students to recognize numerical relationships and perform operations accurately. Students at the concrete operational stage may experience difficulties when addition is introduced primarily through abstract numerical symbols because their logical reasoning is still strongly supported by concrete experiences and observable representations. Therefore, the difficulty of understanding addition at this developmental stage represents an important classroom issue that requires an instructional approach consistent with students' cognitive characteristics.

The chosen learning model must align with the students' current stage of cognitive development. In this context, specifically the "concrete operational" stage, the selected model must address the phase where students are mastering the concept of conservation and performing complex operations, while still relying on concrete references. Since students at this stage often struggle with abstract thinking, teachers must consider this when selecting a learning model. Furthermore, instruction often involves repetition to ensure students fully grasp the material presented.

One learning model that accommodates repetitive learning is the "Drill and Practice" model. According to [Roestiyah \(2008\)](#), the drill technique is a teaching method in which students engage in specific practice activities or drills. The term "drill" implies constant repetition, while "practice" refers to executing actions in a specific field—such as calculating, writing, or sports. The drill method is an instructional approach designed to enable students to solve problems quickly and accurately ([Prayogo, 2022](#)). The drill-and-practice learning model fosters specific habits through continuous repetition, thereby embedding them as ingrained routines ([Kurniawan, 2015](#)). Instruction using the drill-and-practice model engages students in a learning process that relies on their active participation to develop their skills and talents ([Nursehah & Rahmadini, 2021](#)). Previous studies have examined the application of the drill and practice method in supporting students' learning processes and improving their skills and learning outcomes. However, existing studies have tended to focus on the effectiveness of the method in terms of learning achievement and skill acquisition, while the cognitive phenomena experienced by students at the concrete operational stage have received less attention. In particular, how repeated practice through the drill and practice method supports students' cognitive development in understanding addition remains insufficiently explored. Thus, further investigation is needed to understand the application of drill and practice in relation to the cognitive characteristics of students at this developmental stage.

The novelty of this study lies in its focus on the cognitive phenomena of students at the concrete operational stage in the application of the drill and practice method, particularly in learning addition. Unlike previous studies that have primarily emphasized learning outcomes or skill improvement, this study considers the developmental characteristics of students as an

important perspective for understanding the use of repeated practice in mathematics learning. This focus provides a more specific perspective on the application of drill and practice among students at the concrete operational stage. Therefore, this study aims to examine the effect of applying the drill and practice method on the cognitive development of students at the concrete operational stage in learning addition.

Theoretical Review

The theory applied in this study is based on the theory of cognitive development proposed by Jean Piaget. His theory outlines four operational stages in students' cognitive development.

Sensorimotor Stage

The sensorimotor stage (from birth to two years of age) is characterized by the absence of language. Children at this stage are egocentric; they view everything from their own frame of reference, and their psychological world is the only one that exists. By the end of this stage, the child develops the concept of object permanence, meaning they begin to realize that objects continue to exist even when they are not visible. According to Piaget, infants possess innate reflexes that drive them to explore their environment. This stage is marked by the development of spatial understanding and capabilities, unfolding across six substages ([Jahja, 2011](#)): 1) Reflex schemas, appearing from birth to six weeks of age. 2) Primary circular reactions phase, spanning from 6 weeks to 4 months and associated with habit formation. 3) Secondary circular reactions phase, occurring between 4 and 9 months and linked to meaning and vision. 4) Coordination of secondary circular reactions, spanning 9 to 12 months, during which the concept of object permanence develops. 5) Tertiary circular reactions phase, spanning 12 to 18 months, associated with discovering new ways to achieve goals. 6) Onset of symbolic representation, associated with early creativity.

Preoperational Stage

Preoperational thinking (spanning approximately ages two to seven) is divided into two phases: the preconceptual thought phase and the intuitive thought period. The preconceptual thought phase occurs roughly between the ages of two and seven. During this stage, children begin to form simple concepts. They start to classify objects into specific groups based on similarities, although errors still occur in this process. Their logic is neither inductive nor deductive but rather transductive. Meanwhile, the intuitive thought period occurs roughly between the ages of four and seven. At this stage, children are able to solve problems using intuition rather than simple logical rules. The most prominent characteristic of this stage is the child's failure to grasp the concept of conservation. Conservation is defined as the ability to realize that quantity, length, substance, or area remains the same even when represented in a different context. Children in early childhood (ages 2–7) are not yet ready for logical mental manipulation. Another characteristic is the use of representational abilities ([Papalia & Old, 2008](#)). Cognitive advancements in early childhood include: 1) Use of symbols: Children move beyond sensorimotor contact with people, objects, or events; they can mentally represent people or objects. 2) Understanding identity: Understanding that superficial changes do not alter an object's fundamental nature. 3) Understanding cause and effect: Understanding that events have causes and effects. 4) Ability to classify: Organizing people, objects, and events in

meaningful ways. 5) Understanding numbers: Ability to count and work with numbers. 6) Empathy: Ability to sense what others are feeling. 7) Theory of mind: Children engage in mental activities and cognitive functions. Advances in preoperational thinking are accompanied by a growing understanding of space, causality, identity, categorization, and numbers. 1) Symbolic function: The ability to use symbols or mental representations, such as words, numbers, or images, to which one assigns meaning. Possessing symbols that help children think about and recall things in their absence. 2) Symbolic development and spatial thinking, enabling children to make accurate judgments about spatial relationships. Referring to the dual representation hypothesis, what makes the second task more difficult is that it requires the child to mentally represent both the symbol (the small space) and its relationship to the object it represents (the large space) simultaneously. 3) Causality, the understanding of the connection between action and reaction. They engage in transductive reasoning; children tend to mentally link specific phenomena regardless of whether a logical connection exists. 4) Understanding identity, the concept that people and objects remain the same despite differences in shape, size, and appearance—an understanding that underpins the concept of self. 5) Numbers, relating to the concepts of "less" or "fewer" versus "more" or "greater." An immature aspect of preoperational thought is the tendency to focus on one aspect of a situation while ignoring others. In contrast, the ability to move beyond this—to consider multiple aspects simultaneously and understand physical and social relationships—is known as decentering. 1) Conservation, the realization that two quantities remain the same even if their appearance changes, provided nothing is added or taken away. 2) Egocentrism, the inability to consider another person's perspective.

Concrete Operational Stage

During the concrete operational stage (approximately ages seven to eleven or twelve), children begin to demonstrate the ability to conserve, with their thinking grounded in reality. They become capable of performing complex operations, though these remain within concrete rather than abstract parameters. Cognitive advancements at this stage surpass those of the preoperational stage. Children develop a solid understanding of the following (Papalia & Old, 2008) Space and causality: grasping concepts regarding the time required and the spatial relationships between locations. 2) Categorization: involving skills such as seriation (ordering), recognizing relationships between two objects, and understanding the relationship between a whole and its parts. 3) Inductive and deductive reasoning: inductive reasoning involves observing specific instances (people, animals, objects, or events), whereas deductive reasoning involves logical progression toward a generalization or conclusion. 4) Conservation: children are able to work out the answers mentally.

Formal Operational Stage

Formal Operations (approximately ages 11 or 12 to 14 or 15). At this stage, children are capable of handling hypothetical situations, and their thought processes are no longer dependent solely on immediate or concrete realities. Characteristics of this phase include the acquisition of the ability to reason logically, draw conclusions from information, and engage in abstract thinking. From a biological perspective, this stage coincides with the onset of puberty, marked by developments in moral and cognitive reasoning, the physiological transition into adulthood, and social and psychosexual maturation (Jahja, 2011). During this period, the

child's thinking evolves gradually. While the child's thought processes in the preceding period were characterized by imagination and egocentrism, they now develop into rational, objective, and concrete thinking. Memory capacity is strong, and the child is truly in a phase of active learning.

METHODS OF RESEARCH

This study employs a qualitative method with a hermeneutic phenomenological approach. [Sugiyono \(2014\)](#) states that qualitative research is a method rooted in post-positivist philosophy, utilized for research that focuses on the natural conditions of the object of study. According to [Moleong \(2007\)](#), the qualitative method is a form of scientific research aimed at understanding phenomena within a natural social context by prioritizing in-depth communicative interaction between the researcher and the phenomenon under study. This process involves key procedures such as formulating questions, gathering specific data from participants, analyzing data inductively, moving from specific themes to general ones, and interpreting the meaning of the data ([Creswell, 2010](#)).

A phenomenological study seeks to describe and interpret a phenomenon or concept based on the lived experiences of individuals ([Creswell, 2007](#)). This study aims to describe a phenomenon, specifically the teaching practices of elementary school teachers, based on the experiences of one or more individuals. Furthermore, according to Van Manen, hermeneutic phenomenology is a study that aims to describe phenomena derived from lived experiences and to interpret the stories or writings (texts) related to those experiences ([Creswell \(2007\)](#)). It focuses on the relationship between an event, experience, or phenomenon and the individual (participant), as well as how concepts or understandings are derived from that relationship.

Meanwhile, the data collection techniques used in this study are observation and interviews. According to [Arikunto \(2010\)](#), observation involves the direct monitoring of an object within an environment, whether the activity is currently unfolding or in progress, and entails focused attention on the subject of study through the use of the senses. Observation is the act of gathering data through direct examination of the research object's environmental conditions, thereby providing a clear picture of the object itself ([Arikunto, 2010](#)). According to [Emzin \(2016\)](#), there are two roles in observation: participant observation and non-participant observation. This study employs non-participant observation, meaning the researcher acts solely as an observer and does not directly participate in the activities being observed. Through this observation process, the researcher collects data regarding the teaching and learning processes conducted by the teacher. Regarding interviews, [Sugiyono \(2014\)](#) states that they serve as a data collection technique when the researcher aims to understand the research problem and gain in-depth insights from a smaller number of respondents. Citing Esterberg, Sugiyono identifies three types of interviews: structured, semi-structured, and unstructured. This study utilizes semi-structured interviews, wherein the researcher prepares only an outline of questions, allowing the flow of the interview to adapt to the interviewee's responses. The data obtained raise questions concerning validity and reliability.

The subjects of this study were first-grade elementary school students and a teacher from a school in Pemalang Regency. The study involved 20 students. The observation period spanned two lessons, with each session lasting 35 minutes in accordance with the school's

curriculum. The study received approval from the school to conduct research on children's cognitive development. To ensure subject privacy, the identities of the teacher and students were kept confidential, and the subjects' faces were blurred.

Data validity refers to the extent to which the obtained data corresponds to reality, while data reliability refers to the consistency of the data for use. Therefore, data triangulation is employed. According to [Moleong \(2007\)](#), triangulation is a technique for verifying data accuracy by utilizing information other than the primary data for comparison and validation. Triangulation is categorized into three types: source, technique, and time triangulation. This study employs two types: source triangulation and technique triangulation. Source triangulation involves verifying data validity by using more than one source, whereas technique triangulation involves using various data-gathering methods across all data sources ([Helaluddin, 2019](#)). Methodological triangulation was employed by comparing data obtained through two methods: observation and interviews. Observations focused on the teacher's instructional process and student responses to the lessons. Interviews served to deepen the data gathered from observations and also functioned as a form of source triangulation; specifically, the class teacher was interviewed regarding the implementation and rationale behind the teaching methods used.

The collected data are analyzed using several techniques based on the Miles and Huberman model. Miles and Huberman state that qualitative data analysis is conducted interactively and proceeds continuously until completion ([Sugiyono, 2014](#)). There are three steps in data analysis: data reduction, data display, and conclusion drawing.

RESULTS AND DISCUSSION

Instruction is a process of knowledge dissemination from teacher to student. It is an activity involving a learning process that inevitably brings about changes in the learner, specifically regarding knowledge (cognitive), values and attitudes (affective), and skills (psychomotor) ([Devyanti, 2023](#)). Effective instruction also adapts to the students' circumstances, considering the extent of the material to be conveyed and how to structure the learning to align with the child's cognitive development.

The research subjects observed were 6–7 years old, specifically primary school students. Based on Piaget's theory, these subjects are currently in a transitional phase between the Preoperational Stage and the Concrete Operational Stage. Given that the students are in the first grade of primary school, they can be described as being at the early level of concrete operational thinking. This stage comprises several phases, beginning with "progressive decentering" at age seven. Most children at this age have developed the ability to retain information; consequently, in their learning, they tend to remember what is conveyed by the teacher.



Figure 1 the Process of Student Learning by Remembering



Figure 2 the Students Imitate What the Teacher Demonstrated

However, this relates to the transition toward the Concrete Operational Stage, a phase where children begin to grasp concrete concepts, though they still require the support of activities or physical objects. Consequently, teachers employ such activities or objects as instructional methods. Beyond the use of these tangible aids, children at this stage have begun to think concretely; they are capable of performing somewhat complex operations, provided the problems presented are concrete rather than abstract ([Juwantara, 2019](#)). Observations indicate that the teaching process leans toward contextual learning. Although the instruction may not yet be fully concrete in every aspect, the teacher has made an effort to incorporate contextual elements, specifically scenarios familiar to the children in their daily lives, such as using word problems that involve adding three flowers to two flowers.

However, without employing concrete learning approaches, teachers may encounter certain obstacles during the instructional process. One such challenge involves the need for care when presenting the material; teachers must pay close attention to the content to ensure it is conveyed comprehensively to the students. When teaching addition, for instance, the teacher demonstrates step-by-step how numbers are added together. Another challenge arises regarding the repetition of examples. After presenting an initial example, the teacher provides further examples using the same theme but involving different operations. This practice aims to confirm the students' grasp of the material they have learned. By repeatedly providing examples of the same type of problem, the teacher employs the "Drill and Practice" method, which is believed to be more effective in fostering a deep understanding of the subject matter.

According to [Sudjana \(2013\)](#), the Drill and Practice method involves performing the same task repeatedly and earnestly with the goal of perfecting a skill until it becomes ingrained. The drill method emphasizes training problem-solving abilities, aiming to equip students with greater proficiency and skill than what was initially taught ([Ginanjar et al., 2022](#)). Some refer to this as a practice method—one that instills the habit of solving problems through repeated exercise ([Muhibudin, 2021](#)). A defining characteristic of the Drill and Practice method in the classroom is that the teacher presents the material directly.

In this instance, the teacher implements the Drill and Practice method by introducing addition concepts followed by contextual problems. Once the students appear to have grasped the concept of addition, the teacher presents specific addition problems. These problems are solved collaboratively, with the teacher providing strong stimuli to ensure students can follow the problem-solving process. To reinforce understanding of the material, the teacher assigns additional problems for the students to solve independently.

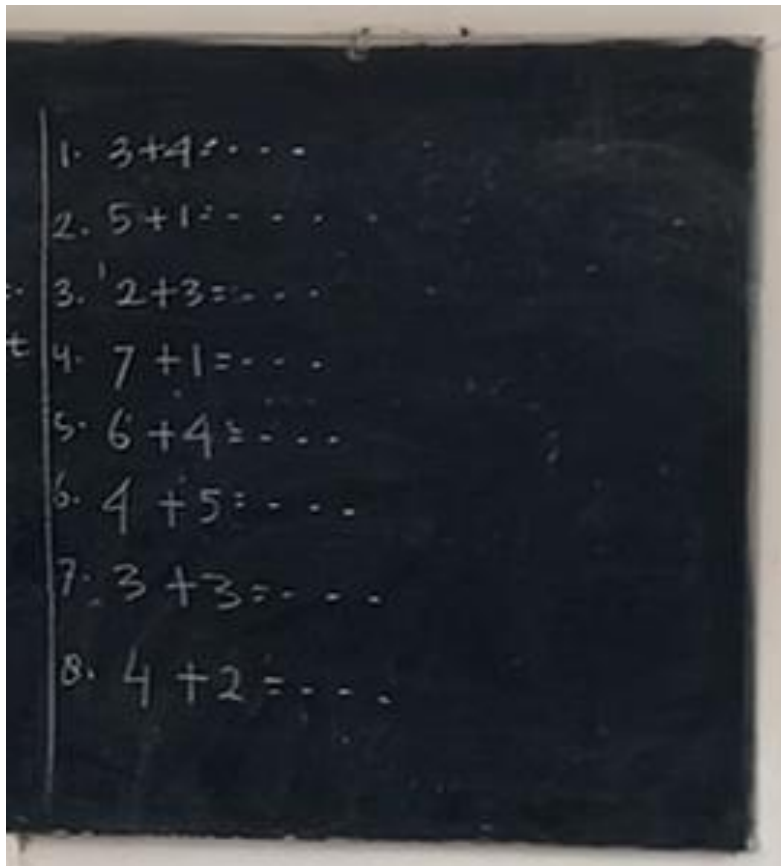


Figure 3 Drill questions given by the teacher

Figure 3 shows that the teacher presented several numerical problems. The problems were of the same type: straightforward addition operations. Assigning such problems has a positive effect on students' cognitive development. Providing drills offers students a greater opportunity to grasp the material taught by the teacher. Students can explore the subject of addition by attempting to solve multiple problems of the same kind. Working through a relatively large number of problems builds confidence after they have observed and understood the solution methods. Furthermore, the variety of problems allows students to validate their understanding.

However, the teacher encountered challenges in implementing the drill-and-practice method. The pace of instruction had to be slow, given that the students were in a concrete thinking phase; they struggled to grasp concepts that lacked concrete representation. Excerpt from an interview with the teacher:

"Students here indeed need to be taught slowly and repeatedly. Material like this can even take up a full day."

The teacher gradually contextualized the problems to ensure the students could follow along. Additionally, this method does not effectively foster conceptual thinking skills; this was evident when students relied on rote memory to solve subsequent problems after watching the teacher demonstrate the solution to the first one. Naturally, students faced difficulties—such as not understanding how to perform the addition—which led them to look at their

classmates' answers. Moreover, the nature of these numerical problems tended to encourage an individualistic approach, with no interaction or discussion regarding how to interpret the problems. In fact, observations revealed that students imitated the teacher's demonstrations using their fingers while vocalizing the counting. Consequently, the classroom became noisy as students began working, forcing the teacher to regain control by re-explaining the addition concepts and ensuring that all students understood the material.

CONCLUSIONS

The study examined students' cognitive development at the concrete operational stage, specifically within a learning process where the teacher employed the "drill and practice" model. As students transitioned from the pre-operational stage, the teacher encountered challenges requiring a cautious, paced instructional approach involving the repetition of material and case examples. The "drill and practice" model was selected to help mitigate these difficulties; by repeatedly assigning a large volume of practice problems, the teacher was able to partially overcome the obstacles faced during instruction. However, the implementation of this model presented its own challenges: students tended to prioritize rote memorization over a conceptual understanding of addition operations when solving problems. Furthermore, the lack of interaction regarding how to comprehend the assigned problems led to widespread individual confusion; this simultaneous confusion created classroom noise, ultimately requiring the teacher to devote extra attention to the students. The researcher recommends implementing cooperative learning through small-group discussions to reduce the tendency to memorize without understanding the concepts being taught. The researcher acknowledges certain limitations in this study, including the relatively short observation period—specifically, observations conducted during only two instructional sessions.

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