Revisiting Piaget's Preoperational Cognitive Milestones in Digital Era: Educational Implications

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ABSTRACT: According to cognitive development theory of Jean Piaget, children in their preoperational stage of cognitive development cannot perform certain tasks; conservation being one of them. Preoperational stage consists of non-conservers from age 3 to 7. However, conservation is observed to be initiated from early ages but experimental research-based evidence is required to observe this phenomenon. This paper explores the age deviancy in performing conservation tasks (number, mass, and volume) within Piaget's preoperational stage. Employing a cross-sectional method, the research involves 135 children aged 3-7, grouped into early, mid, and end preoperational stages. Standard preoperational conservation tasks were performed with children. Their parents, mostly mothers were also interacted to discuss how children come in contact usually interact with environment to solve their problems. The findings show that children attain conservation tasks sooner than previously thought, with number conservation at the earliest. Informal talks with their parents lead to believe that this earlier acquisition of cognitive milestones may be attributed to children's frequent interaction with forms of technology. As conservation is observed to be achieved earlier than expected, it is recommended that early education should therefore serve as the cornerstone for subsequent learning whereas, the primary role of preschools ought to facilitate the shift from pre-operational intelligence to concrete intelligence.

KEYWORDS: Piaget's Theory of Cognitive Development, Preoperational Stage, Early Conservation Development, Children's Interaction with Digital Devices

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Introduction

The 20th century witnessed the emergence of prominent cognitivists like Bruner, Miller, and Ausubel, among whom Jean Piaget stands out for his influential theory of learning and cognitive development (Piaget, 2000). Piaget's work not only revolutionized our understanding of child development but also left a profound impact on education and curriculum design. Piaget's stage theory of cognitive development has informed curriculum development by providing a framework for understanding the development of children's cognitive abilities. He conducted research on how children create mental models of the world. His theory of cognitive development comprises the sensorimotor stage (birth to age 2), the preoperational stage (ages 2 to 7), the concrete-operational stage (ages 7 to 11), and the formal-operational stage (ages 11 and above) (Piaget, 2000). However, Piaget's assumption that cognitive development progresses through universal and sequential stages has been widely debated. Contemporary research

suggests that children's cognitive development is more flexible and influenced by environmental, cultural, and educational contexts than Piaget originally proposed. Consequently, many researchers argue that cognitive abilities develop gradually rather than through rigid stage transitions (Babakr et al., 2019; Berk, 2023; Santrock, 2021).

Although Piaget's theory has made a large contribution to developmental psychology and educational practice, it has also been the target of considerable criticism. According to contemporary researchers, children's cognitive development is more context-dependent, flexible, and gradual than Piaget initially suggested. Recent studies have questioned the validity of various Piagetian tests, the universality of Piaget's developmental stages, and the notion that children advance through fixed and sequential stages (Babakr et al., 2019; Berk, 2021; Santrock, 2021).

Technology serves as cognitive acceleration. It helps people learn faster and better in many ways. For example, it makes it easier to access more information, so no matter what we can learn about, there are interesting websites and applications that make learning fun and help us think more clearly. Technology can also adjust how well everyone learns, so everyone can learn at their own pace. And with smartphones and tablets, one can learn irrespective of the place, making learning easier and more flexible (Bond et al., 2024; UNESCO, 2023).

The question arises whether the technologically enabled cognitive capabilities have sped up the acquisition of conservation capacities. Could it be that children raised in the digital environment of the twenty-first century have an earlier mastery of conservation tasks than children raised in Piaget's time or in the pre-digital period as a result of these technological advances? Previous studies cited above have limited generalizability, i.e., the study conducted by Berk (2023) carried out the research on just one 3-year-old child, and the spans in the preoperational stage were holistic, i.e., combined ages of children of 2-7 years. They haven't targeted a specific age period within this range. Along with that, previous research has put forward the phenomenon and has replicated the study of Piaget but without providing the actual reason for conservation being achieved early nowadays and not during the Piagetian era.

In this paper, we will explore the deviancy in age group for the achievement of conservation tasks (number, mass and volume) and the influence of technology usage on this age deviance. By exploring this bridge between traditional theories and innovative tools, we gain a more comprehensive perspective on the interplay between cognitive development, educational practices, and the digital age.

Literature Review

According to Piaget, every stage of cognitive development has a coherent framework that is applicable to all areas of thought. However, subsequent studies have revealed that children's reasoning skills often differ between tasks and situations, indicating that social interaction, language, experience, and prior knowledge all have an impact on cognitive development rather than just age (Berk, 2023; Siegler & Alibali, 2020). As a result, children may exhibit complex reasoning in settings they are familiar with, but less sophisticated thinking in situations they are not. Recent research is continually refining Piaget's original concept rather than rejecting it entirely. Studies on cognitive development indicate that young children can acquire certain cognitive skills much earlier than Piaget predicted. This happens when they are provided with appropriate instructional support, repeated experiences and enriched learning environments (Babakr et al., 2019; Berk, 2023). Likewise, research on theory of mind has demonstrated that children of 4-5 years of age can understand that people have beliefs, intentions and perspectives that differ from their own. This suggests that young children are often less egocentric than Piaget originally described (Wellman, 2021; Berk, 2023).

These findings imply that children's cognitive capacities are more complex and diverse than Piaget first predicted. His theory is increasingly seen by modern educators as a fundamental framework that may be expanded by more recent data on children's learning, social interaction, and cognitive development rather than as a definitive

explanation of cognitive development. Teachers can create developmentally appropriate learning experiences that better support children's cognitive development by combining Piagetian concepts with current developmental research (Santrock, 2021; Berk, 2023). Accordingly, the present study focuses on the concept of conservation among children in the preoperational stage (3–7 years), while acknowledging contemporary perspectives on children's cognitive development.

The results of Piaget's tasks previously performed by researchers were as follows:

- **Number:** Two rows of coins (C1, C2) were made, accompanied by the same number of coins. Children were asked to confirm if both rows had the same coins. Then one row was made longer than the other, and children were asked the same question. During 2003, only children aged 6-7 were able to answer correctly (Eisenberg, 2003), while in 2014, children aged 4-7 were also able to achieve conservation (Asokan et al., 2014).
- **Volume:** Children were shown two glasses (G1, G2) having the same size and the same amount of water. They were asked if both glasses contain the same amount of water. Then the water in G2 was transferred to another glass having a different size than G1, and children were asked if the amount of water had changed after being transferred. Children aged 6-7 were able to achieve conservation, while a study conducted by Watanabe (2017) shows that conservation can also be achieved by a 3-year-old but lacks further research.
- **Mass:** Two pieces of clay (M1, M2) were taken of the same quantity, rolled into a circle, and children were asked if both are the same. Then M1 was turned from a circle into a more flattened shape, and then children were asked if both M1 and M2 are of the same quantity. Children aged 6-7 were able to achieve this conservation (Watanabe, 2017).

Piaget's influence on education is evident in different countries, each incorporating their ideas into their educational programs. In Australia, Arthur et al. (2018) discuss how Piagetian ideas shape early childhood education.. Switzerland, being the birthplace of Piaget's work, naturally incorporates his ideas into education, as evidenced by the articles in the Handbook of Child Psychology (Damon & Lerner, 2006). Finally, the New Zealand Ministry of Education (2017), embraces Piaget's emphasis on child-led learning and appropriate development, as accepted in its early childhood curriculum.

In this review, we will explore the intricate connection between Piagetian Pre-operational conservation tasks and technology, shedding light on how advancements in technology have reshaped the way we both assess and facilitate children's cognitive development in the contemporary era (Kuhn, 2008). The use of touchscreen devices and mobile technologies among young children has increased substantially over the past decade, making digital media an important part of many children's everyday learning experiences (UNESCO, 2023; WHO, 2019). Children use a variety of cognitive and physical skills when interacting with touchscreen devices, such as attention, working memory, executive functioning, hand-eye coordination, spatial reasoning, and problem-solving. Well-designed educational applications can assist these abilities by offering engaging, developmentally appropriate learning experiences; however, their efficacy depends on the quality of the content and adult direction (OECD, 2023; UNESCO, 2023; Madigan et al., 2020).

Piaget's concepts of conservation help teacher educators to evaluate the current level of children in the preoperational stage and plan curricular and academic activities accordingly. It also helps educators to provide relevant scaffolding to help them progress to the next stage. Teachers design lesson plans and activities that align with the cognitive stage of the child and encourage exploration and discovery. But outdated curriculum and using previously generated theoretical concepts within an educational framework in this digital age could result in lower student motivation and lack of teacher-student understanding (MacQueeney, 2022).

The age at which children learn about conservation is a topic of continuous discussion. Although Piaget proposed that conservation emerges around 6–7 years of age, recent research suggests that some children can demonstrate

conservation even earlier when tasks are appropriately designed and supported. However, there is still a lack of knowledge on the impact of modern environmental elements and technological exposure on previous conservation development (Babakr et al., 2019; Berk, 2023).

Research Objectives

1. To investigate the deviancy in age group for the achievement of conservation tasks in Piaget's preoperational stage.
2. To find out the trend of conservation tasks (number, mass, volume) in Piaget's preoperational stage.

Methodology

Research Design

The research was cross-sectional in nature as participants of the study were children from various age groups being tested in a unit time frame. However, it took almost 5 months to complete the tasks with all children.

Population and Sample

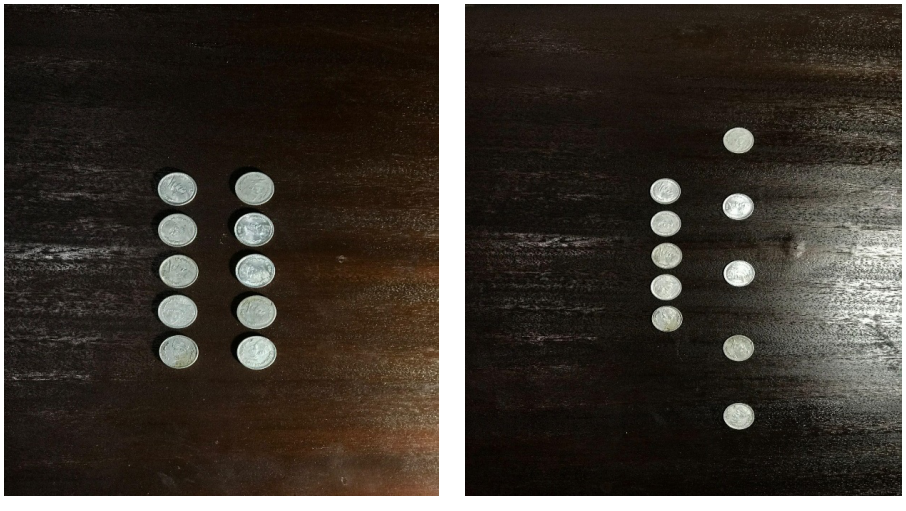
Children in their preoperational stage enrolled in preschools or regular schools constitute the population of the study. 20 schools, including Montessori/ Preschools of the 2nd largest metropolitan city of Pakistan with diverse socioeconomic backgrounds, were selected to access the target population. School administration was introduced with the purpose and type of activities/tasks, mostly being already familiar. Parents' consent for participation of their children as well as their own time was obtained through school administration. 135 children were selected. Each child was scheduled to be interacted with 3 times a week to complete the cycle of tasks, along with an informal talk with their parents. Of the parents who interacted, almost 90 % (n=121) were mothers, while almost 10 % (n=14) were both parents. The ages of the children were tabulated and calculated in the week of interaction for data analysis. Most children included in the study were between 4.5 and 5 years old.

Tasks Performance

The tasks used in the study were identical to those of Piaget's tasks. No amendments were made to any of the three tasks of conservation of mass, volume and number. All three tasks were completed with every single child separately without any influence of one on the other.

Figure 1

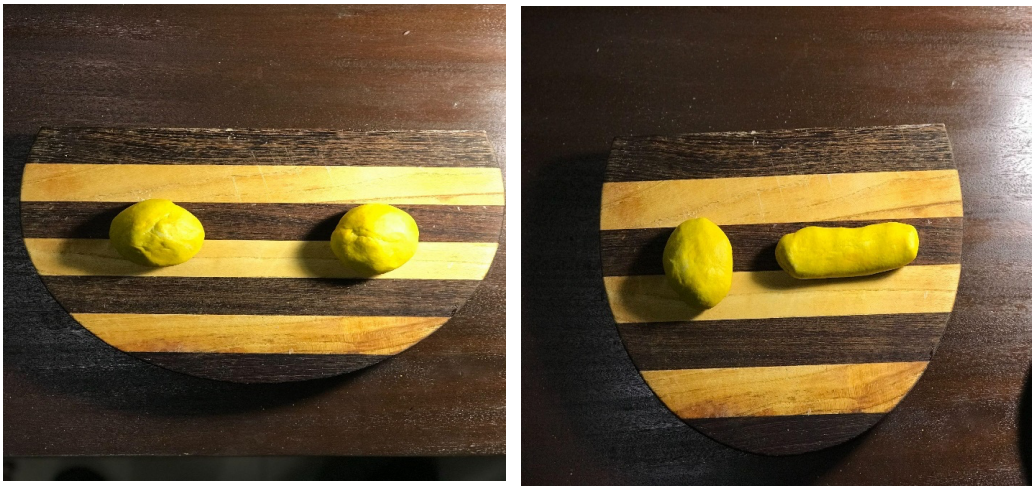
Task for Conservation of Number



- **Number:** Two rows of equal number of coins (Row A and Row B) on the table in front of the child. The child was asked whether the number of coins in both rows is the same or not. Then, the coins in Row A were scattered lengthwise, and Row B was kept intact. The child was again questioned whether the number of coins in both rows was the same or not. (Note: All responses are observed and noted with no addition to them).
- **Mass:** Two identical balls of clay (A and B) were presented to the child on the table. The child was asked whether the two balls were identical or not. Then the clay ball A was molded into a cylindrical shape and clay ball B was kept intact. The child was asked again whether the two balls are identical or not. (Note: All responses are observed and noted with no addition to them).

Figure 2

Task for Conservation of Mass



- **Volume:** Two glasses (A and B) of the same size with the exact same amount of water were placed in front of the child. The child was asked again whether the two glasses have the same amount of water or not. Then the water in glass A was transferred to another glass having a different size than glass A and glass B, and the child was asked if the amount of water had changed after being transferred. Note: (All responses are observed and noted with no addition to them).

Figure 3

Task for Conservation of Volume

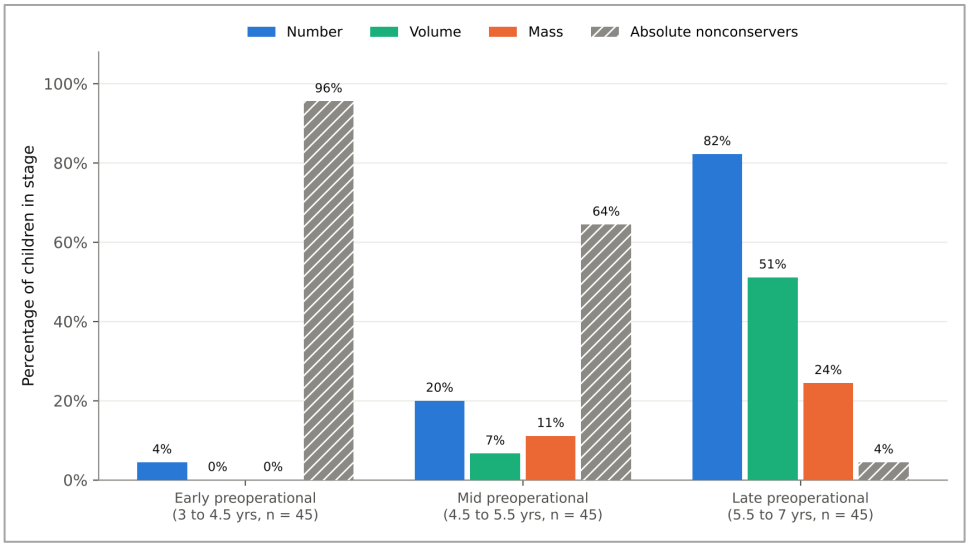


Results

Conservation by Preoperational Substage

Figure 4

Percentage of children in each substage (n = 45 per substage) who conserved number, volume and mass, and percentage who were absolute nonconservers.



- **Early preoperational:** almost all children (96%) were absolute non-conservers.
- **Mid preoperational:** non-conservers dropped to 64%. All three forms of conservation appeared, but remained a minority: number 20%, mass 11% and volume 7%.
- **Late preoperational:** The picture is reversed. Non-conservers fell to just 4%, while number conservation reached 82% and volume 51%. Mass rose only to 24%.
- The largest change happens between mid and late preoperational. Number conservation jumped by 62 percentage points, volume by 44 points, and the share of non-conservers fell by 60 points. By comparison, the change from early to mid was modest.

Where the Data Support Piaget

- Children under 4 failed every conservation task, which is consistent with centration, irreversibility and perception-driven judgement in the preoperational stage.
- Conservation emerged gradually through the intuitive substage rather than appearing suddenly, which matches Piaget's description of transitional levels.
- Number was conserved first and was almost fully mastered by age 7, in line with Piaget's age norms.
- Mass lagged well behind number, which demonstrates horizontal décalage and matches Piaget's later age norm for conservation of substance.
- By the end of the preoperational period, almost no child was a complete non-conserver, which signals readiness for the concrete operational stage.

Where the Data Depart from Piaget

Early number conservation. Two children aged 4 to 4.5 years conserved number, which is earlier than Piaget would predict. This is in line with later research suggesting that Piaget underestimated young children. Gelman (1972)

showed that preschoolers can conserve small numbers when the task is simplified, and McGarrigle and Donaldson (1974) found that far more 4- to 6-year-olds conserved when the transformation was made to look accidental (the "naughty teddy" study) rather than deliberate. Children may fail the standard task partly because being asked the same question twice by an adult implies that the answer should change.

Volume ahead of mass. In this sample, volume (51% in the late substage) was conserved more often than mass (24%). If the volume task was the classic liquid task, where water is poured from a short, wide glass into a tall, thin one, this result fits Piaget, because conservation of liquid quantity is expected at about 6 to 7 years, before mass. If it was a true displaced volume task, such as predicting the water level when a clay ball is reshaped, then the result contradicts Piaget, who placed that form of conservation at about 11 to 12 years. The interpretation of this column therefore depends on how the task was administered.

Parents' Account of Children's Experiences

During task administration, informal discussion regarding the corresponding child's experience and interaction with his/her environment was conducted with their prior consent. All parents, though mostly the mothers, eagerly expressed their views. Parents were encouraged to share anything about their children; their abilities, interests, activities, issues or anything they want to share. Important points were being noted in writing. Parents' experiences about their children are summarized as:

- All children are exposed to any form of digital technology regardless of their gender and the socio-economic status of their parents.
- Children prefer, when it comes to their choice, to interact with digital devices rather than traditional toys.
- Children gossip with each other about their respective devices.
- Screen time of younger children is higher than that of older children.
- Children demonstrate a good command of operating devices regardless of their age.
- Most Children are aware of the battery timing icon. They return it to their elders to charge before it gets powered off.
- They can switch the channel and operate the remote in ascending or descending order of channels.
- They play digital games including cash games, food making games, dress up and fashion games, and food making and serving games.
- A few children had their personal tablets.
- Children are aware of AI, and they believe it can answer anything.
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Discussion & Conclusion

The primary objective of this study was to compare the acquisition of conservation tasks across different age groups during Piaget's preoperational stage. Although Piaget proposed that conservation typically emerges during the concrete operational stage (approximately 6–7 years of age), subsequent research has suggested that younger children may demonstrate conservation earlier when tasks are developmentally appropriate with proper instructional support (Gelman, 1969; Babakr et al., 2019; Berk, 2023). Consistent with this perspective, the findings of the present study indicate that some children demonstrated conservation abilities as early as three years of age. These findings suggest that the emergence of conservation may occur earlier than traditionally proposed and that its development may be influenced by factors beyond chronological age alone.

According to the findings of the present study, conservation skills appeared earlier than traditionally proposed by Piaget, with 2 children demonstrating an understanding of number conservation as early as the initial period of

their preoperational stage. One possible explanation for this finding is children's increased exposure to numerical concepts through digital technologies and everyday interactions with electronic devices. Educational applications, interactive games, and multimedia resources provide frequent opportunities for children to engage with numbers, counting, and problem-solving activities. This may support early cognitive development (Organisation for Economic Co-operation and Development [OECD], 2023; United Nations Educational, Scientific and Cultural Organization [UNESCO], 2023). Similarly, interactive digital activities that involve comparison, classification, and balance may contribute to children's understanding of mass conservation. While play-based digital simulations that involve liquids may support the development of volume conservation. Although technology exposure was recorded as part of the study, the present research did not directly examine its relationship with conservation performance. Nevertheless, children's frequent interaction with digital technologies may represent one possible factor contributing to the earlier emergence of conservation observed in this study. Future research should investigate this relationship using more rigorous analytical approaches (UNESCO, 2023). Overall, the findings suggest that Piaget's theory continues to provide a valuable framework for understanding cognitive development but should be interpreted alongside contemporary educational and technological contexts.

According to Piaget's argument, children "cannot" reach particular cognitive milestones before reaching particular ages or developmental stages (Piaget, 2000). Our empirical results, however, do not reject Piaget's theory, but these results indicate that the timing of cognitive development may be more flexible and influenced by individual differences and contemporary learning experiences than previously assumed (Babakr et al., 2019; Berk, 2023). These findings highlight the need for continued research to better understand the factors that contribute to the earlier emergence of conservation skills and to refine our understanding of cognitive development in early childhood.

Overall, the findings support the continued relevance of Piaget's theory as a foundational framework for understanding cognitive development. It also suggests that the timing of developmental milestones may be more flexible than originally proposed. Rather than rejecting Piaget's theory, this study contributes to its ongoing refinement by highlighting the need to consider contemporary educational contexts and learning experiences when interpreting children's cognitive development.

Suggestions & Educational Implications of the Findings

Piaget's cognitive theory has a strong impact on many education systems. The deviations found in the current study imply that conservation is being achieved earlier than how it was conceived previously. Basic concepts related to numbers and their simple operations may be introduced to children at early ages. However, since it was found that most children were unable to achieve conservation at the early preoperational stage, concrete experiences and activity-based learning may help children acquire and build the foundation of the concepts. Since children reach conservation at different rates, individual differences should be the primary concern of teachers. Concepts related to numbers may be sequenced in preschool curriculum earlier than other quantitative concepts like mass and volume, for which conservation was found to be acquired in the study later than numbers. The sharp gain between the mid- to late preoperational stage may indicate that the transition stage may arrive earlier, and teachers may focus on preparing children for logical thinking. This variation, together with evidence that task wording and context affect young children's performance (McGarrigle & Donaldson, 1974), argues for assessing each child informally in familiar, meaningful situations rather than grouping them by age alone (Siegler & Alibali, 2020). Hence, children's context should also be considered as relevant as their age and other factors affecting their development.

References

Arthur, L., Beecher, B., Death, E., Dockett, S., & Farmer, S. (2018). *Programming and planning in early childhood settings* (7th ed.). Cengage Learning Australia.

Asokan, S. S. (2014). Relevance of Piaget's cognitive principles among 4–7-year-old children: A descriptive cross-sectional study. *Journal of Indian Society of Pedodontics and Preventive Dentistry, 32*(4), 292–296. https://doi.org/10.4103/0970-4388.140953

Babakr, Z. H., Mohamedamin, P., & Kakamad, K. (2019). Piaget's cognitive developmental theory: Critical review. *Education Quarterly Reviews, 2*(3), 517–524. https://doi.org/10.31014/aior.1993.02.03.84

Berk, L. E. (2023). *Development through the lifespan* (8th ed.). Pearson.

Bond, M., Khosravi, H., De Laat, M., Bergdahl, N., Negrea, V., Oxley, E., Pham, P., Chong, S. W., & Siemens, G. (2024). A meta systematic review of artificial intelligence in higher education: A call for increased ethics, collaboration, and rigour. *International Journal of Educational Technology in Higher Education, 21*, Article 4. https://doi.org/10.1186/s41239-023-00436-z

Gelman, R. (1969). Conservation acquisition: A problem of learning to attend to relevant attributes. *Journal of Experimental Child Psychology, 7*(2), 167–187. https://doi.org/10.1016/0022-0965(69)90030-7

Gelman, R. (1972). Logical capacity of very young children: Number invariance rules. *Child Development, 43*(1), 75–90.

MacQueeney, P. L. (2022). Applying Piaget to classroom teaching: Stage development and social learning theory. In *Theories, strategies and semiotic tools for the classroom*. IntechOpen.

Madigan, S., McArthur, B. A., Anhorn, C., Eirich, R., & Christakis, D. A. (2020). Associations between screen use and child language skills: A systematic review and meta-analysis. *JAMA Pediatrics, 174*(7), 665–675. https://doi.org/10.1001/jamapediatrics.2020.0327

McGarrigle, J., & Donaldson, M. (1974). Conservation accidents. *Cognition, 3*(4), 341–350.

Organisation for Economic Co-operation and Development. (2023). *PISA 2022 results (Volume I): The state of learning and equity in education*. OECD Publishing. https://doi.org/10.1787/53f23881-en

Piaget, J. (2000). Piaget's theory of cognitive development. In K. Lee (Ed.), *Childhood cognitive development: The essential readings* (pp. 33–47). Blackwell.

Santrock, J. W. (2021). *Life-span development* (18th ed.). McGraw-Hill Education.

Siegler, R. S., & Alibali, M. W. (2020). *Children's thinking* (5th ed.). Pearson.

United Nations Educational, Scientific and Cultural Organization. (2023). *Global education monitoring report 2023: Technology in education: A tool on whose terms?*

Watanabe, N. (2017a). Acquiring Piaget's conservation concept of numbers, lengths, and liquids as ordinary play. *Journal of Educational and Developmental Psychology, 7*(1), 210.https://doi.org/10.5539/jedp.v7n1p210

Wellman, H. M. (2014). *Making minds: How theory of mind develops*. Oxford University Press.

World Health Organization. (2019). *Guidelines on physical activity, sedentary behaviour and sleep for children under 5 years of age*. WHO.