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**Difficulties in the use of numbers among children aged 8 to 10 years
a field study in the city of Laghouat using the UDN-II Battery**

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Abstract

This study aims to screen for the difficulties children experience in using numbers. It was guided by two central questions: Do children encounter difficulties in using numbers? And at which specific levels do these difficulties emerge? To address these questions, the descriptive method was adopted, and the “Use of Numbers” tests developed by Claire Meljac and Gilles Lemmel were administered. These included the Shape Cards Test, the Practical Use of Numbers Test, the Comparison Test, and the Quantitative Reasoning Test. The sample consisted of 37 children between the ages of 8 and 10 years.

Following the analysis and interpretation of the results, the findings revealed that the most prominent difficulties appeared in tasks presenting notable challenges, particularly in the item related to the principle of order irrelevance, followed—though to a lesser extent—by the item concerning the comparison of large groups. In contrast, relative ease was observed in mastering the remaining counting principles proposed by Gelman, as well as in applying numbers in practical problem-solving tasks and quantitative reasoning activities.

Key words: screening; use of number; difficulties in the use of number.

Introduction

Childhood represents a pivotal stage in human development, during which the child’s early traits begin to take shape and the foundational bases of concepts are established. These foundations continue to evolve in line with the child’s life experiences and growing abilities, eventually becoming an integral part of daily life.

At this stage, children acquire a wide range of skills and concepts that contribute to their overall development. They engage in various activities that train and refine their senses while expanding their knowledge and experiences, including those related to mathematics (Zaghloul, 2022, p. 716).

Among these, mathematical knowledge occupies a central role as one of the essential cognitive abilities children must acquire in order to solve mathematical problems. In the early phases of cognitive development, such knowledge is considered preliminary learning that requires mastery of the basic principles of counting (Sahraoui, 2019, p. 2).

Numbers, in this context, are defined as the child's capacity to recognize numerical symbols and link them with the quantities they represent. This ability not only supports the child's intellectual and social development but also enhances their understanding of different aspects of life. Given the importance of numbers as the backbone of mathematical learning, it becomes essential to evaluate the different systems that constitute this concept, drawing on theoretical models of its development in children. Such evaluation therefore represents a fundamental step in understanding and supporting children's mathematical growth.

1. Problem statement

The flexible and accurate use of numbers is one of the most important indicators of cognitive development in primary school, serving as a gateway to more advanced mathematical concepts. By the ages of 8 to 10, children are generally expected to have consolidated their basic numerical skills and to be able to apply them across a variety of contexts. Yet, educational observations suggest that many children continue to experience persistent challenges in this area—challenges that are not always reflected in traditional measures of academic performance. These are not occasional mistakes, but rather genuine obstacles in the use of numbers that call for careful screening and precise characterization.

The academic understanding of how the concept of number develops has long been the subject of theoretical debate, shaping the way educators and researchers approach teaching and assessment. Jean Piaget, through his constructivist theory, argued that number is not a physical property of objects but a mental construct that emerges gradually through the child's interaction with the environment. According to Piaget, this construction progresses through key developmental stages, particularly the acquisition of cognitive operations such as sequencing and classification. He regarded the mastery of the principle of conservation of quantity as the critical milestone that indicates a child's full comprehension of number (Amoura, 2014, p. 04).

Building on but also questioning this view, Jacques Grégoire (2017) emphasized that while Piaget's model remains foundational, it should not be seen as the sole framework. Rather, it must be complemented by other theoretical perspectives to better capture the diverse forms of difficulty that children may encounter. This plurality of models has significant implications for diagnostic practices, underscoring the need for specialized assessment tools that go beyond general diagnoses to identify the specific types and levels of difficulty with greater precision (Paul, 2020, p. 09).

Within this context, the central question emerges: how can the nature and levels of children's difficulties in number use be determined at this advanced stage of primary education? Claudine's evaluation of second- and fifth-grade students provides a compelling example: she observed difficulties in both arithmetic operations and problem-solving, which she attributed to weaknesses in acquiring and internalizing the concept of number. In her view, a successful mathematics learner is one who has developed a solid understanding of number and can handle numbers with confidence, whereas a struggling learner often lacks this conceptual foundation (Claudine, 2009/2010, p. 03). For instance, a child may count mechanically without grasping the key principle that the last number counted represents the total quantity of the set. Another child may perform simple arithmetic operations but struggle to shift flexibly between problem-solving strategies.

It is precisely these subtle distinctions that require careful exploration. To uncover such complex patterns of difficulty, it is necessary to employ specialized tools such as the UDN-II test. This instrument offers a structured framework for identifying deficits in numerical skills, allowing specialists to understand the underlying nature of the problem rather than merely noting its surface manifestations. Against this background, the present study seeks to examine whether the children in the sample face difficulties in number use, through the application of the UDN-II test, and to determine the specific levels at which such difficulties arise.

2. Significance of the study

The importance of this study lies in its focus on a pressing educational challenge: the difficulties children encounter in using numbers—one of the most abstract and complex concepts they must master. Understanding the nature of these difficulties and uncovering their underlying causes is essential for shaping effective teaching approaches, improving curricula, and adopting methods that align with the developmental needs of this age group.

This significance becomes even clearer when we consider the limited amount of research that directly addresses the construction and use of numbers, despite their central role in children's cognitive development. By shedding light on this often-overlooked area, the study aims to open new avenues for research, provide a more accurate picture of the problem's scope, and suggest practical strategies for addressing it.

In addition, the study contributes to the enrichment of the field by offering tools and insights that may support researchers, educators, and specialists who are interested in numerical learning. The findings and recommendations presented here can serve not only as a foundation for further studies but also as a basis for expanding research samples and refining diagnostic and teaching practices.

3. Objectives of the study

This study was designed with the following objectives:

- To explore the difficulties children encounter in using numbers, through the application of number-use tests drawn from the UDN-II battery.
- To pinpoint the specific levels at which these difficulties emerge within the target group of children.
- To gain a deeper understanding of the nature and causes of these difficulties, by examining children's behavior from two complementary perspectives: first, the mental structures that support mathematical thinking—such as their conceptual grasp of numbers—and second, their ability to apply mathematical concepts in practical, everyday situations.
- To provide a solid methodological basis for educators and specialists, offering findings that can guide the design of targeted programs to address difficulties in number use.

4. Operational definitions of the study terms

4.1. Screening (Detection):

In this study, screening refers to the process of identifying the difficulties children face in using numbers. This was done through selected tests from the UDN-II battery, including the Shape Cards Test, the Practical Use of Numbers Test, the Comparison Test, and the Quantitative Reasoning Test. Children's performance and behavior were carefully observed and analyzed, allowing their difficulties to be classified according to the criteria outlined in the battery.

4.2. Use of numbers:

This term describes a child's ability to apply numbers in meaningful and practical ways. It is a broad concept that covers several functional aspects, such as reasoning quantitatively, comparing numbers, and using them effectively in real-life tasks.

4.3. Difficulties in number use:

These are the errors or obstacles children encounter while engaging with number-related tasks. Such difficulties can be systematically observed and measured through the UDN-II battery and its components: the Shape Cards Test, the Practical Use of Numbers Test, the Comparison Test, and the Quantitative Reasoning Test.

5. Methodological procedures of the study

5.1. Research method:

A research method is the approach chosen to achieve a specific research goal (Dhuriyan, 2019, p. 3). Because different studies demand different approaches, the choice of method must align closely with the nature of the problem under investigation.

In this case, the **descriptive method** was selected, as it allows for the classification, analysis, and interpretation of data in ways that match the objectives of the study. This method relies on careful observation and monitoring of the phenomenon to better understand its current state or to identify its ideal conditions according to established criteria (Al-Nuaimi et al., 2015, p. 227).

5.2. Temporal and spatial boundaries:

The fieldwork for this study took place from May 5 to August 2, beginning with sample selection, followed by test administration and scoring, and concluding with data entry and analysis.

Spatially, the study was conducted at Mohamed Bouazouz Primary School, 400 Social Housing Estate, Laghouat. This school was chosen because of the researcher's professional ties with the staff, particularly the school psychologist, who is a colleague. In addition, the school provided a quiet, dedicated classroom, which was highly suitable for administering the tests.

5.3. Study sample:

The sample consisted of 37 primary school children (22 boys and 15 girls), aged between 8 and 10 years. Selection was intentional, based on the age requirements for the study tool, with children's ages verified through their official school records.

Children with intellectual, physical, or sensory disabilities were excluded from participation—whether identified by the researcher, reported by teachers, or documented in medical records.

With regard to gender distribution, all children who met the inclusion criteria were admitted into the sample, ensuring that the final group represented both boys and girls within the target age range.

5.4. Study tools

For this research, the main tool was the “**Use of Numbers**” tests taken from the *UDN-II Battery* (Construction and Use of Numbers), originally developed by **Claire Meljac and Gilles Lemmel**. From this battery, four components were selected: the Observation (Counting) Test, the Practical Use of Numbers Test, the Comparison Test, and the Quantitative Reasoning Test.

5.4.1. General description of the battery

The *Construction and Use of Numbers Battery (UDN-II)* is widely recognized as one of the most significant tools for assessing children’s educational development, particularly their numerical abilities. It was designed to evaluate difficulties in understanding and applying logical and mathematical concepts in children aged **4 to 11 years**. Developed in 1999 by Meljac and Lemmel, the battery draws heavily on the principles of **Jean Piaget**, whose theories on cognitive development shaped much of its structure.

The UDN-II battery has several key objectives:

- To examine the logical structure of a child’s thinking through a clinical, Piagetian lens.
- To observe children’s behavior from two complementary perspectives: first, how they construct mathematical thought, and second, how they use mathematical concepts in daily life.
- To avoid rigid testing procedures by providing supportive prompts. When a child struggles with a task, they are always offered a “second chance,” ensuring that assessment is more flexible and child-centered.

Scoring in UDN-II is based on three performance levels, consistent with Piaget’s developmental framework:

- Failure (Échec – E)

- Intermediate (Intermédiaire – I)
- Success (Réussite – R)

For each age group and test, specific percentage thresholds determine these levels. Each subtest is also linked to a “key age” (âge-clé), defined as the age at which fewer than 10% of children in the standardization sample failed, while more than 75% achieved success.

The UDN-II battery itself is comprehensive, composed of five main families of tests:

1. Conservation tests
2. Elementary logic tests
3. Number-use tests
4. Spatial origin tests
5. Knowledge test

5.4.2. Description of the number-use tests applied in the study

The present study focused on the number-use tests within the UDN-II battery. These consist of the following subtests:

- **Shape cards (Counting):** Designed to assess how children group quantities and apply Gelman’s principles of counting.
- **Practical reasoning with numbers:** Evaluates whether children can recognize numerical equivalence and establish relationships between two sets presented in different perceptual fields.
- **Comparison test:** Measures children’s understanding of comparative terms, the flexibility of their reasoning, and their ability to mentally reverse a statement.
- **Quantitative reasoning:** Focuses on the concept of one-to-one correspondence, a fundamental building block of mathematical reasoning.
- **Test E (Optional):** Explores the strategies children employ to construct a numerical set equivalent to a reference set presented to them.

5.4.3. Battery tools

Behavioural Recording Booklet: The behavioural recording booklet served as the main tool for documenting children’s information and test performance. The first page contained basic personal details, while the following pages were dedicated

to recording both observations and test results. Each response was classified into one of three categories:

- **Inadequate response (NA):** when the answer showed no alignment with the expected outcome.
- **Approximate response (AP):** when the answer showed partial understanding or a near-correct attempt.
- **Adequate response (AD):** when the answer fully met the expected standard.

At the conclusion of each test, the child's overall performance level was summarized as **Adequate**, **Approximate**, or **Inadequate** (Claire M. & Gilles L., 1999, pp. 15–36).

6. Presentation, analysis, and interpretation of results

6.1. Presentation and analysis of results

This section presents the performance levels of the participants, expressed as percentages calculated from their raw scores. The analysis includes both a quantitative overview, explained through tables, and a qualitative interpretation offered directly after each test.

Table 01: Percentage of success in the shape cards test (Counting)

Test component	One-to-One correspondence	Stable order	Cardinal principle	Irrelevance of order
Number of cases (N = 37)	37	33	25	11
Percentage of success	100%	89.18%	67.56%	29.72%

The table highlights that all participants (100%) mastered the Principle of One-to-One Correspondence, making it the strongest area of performance. The second-highest success rate was achieved in the Principle of Stable Order (89.18%), followed by the Cardinal Principle (67.56%), which showed moderate success. The most challenging area proved to be the Principle of Irrelevance of Order, with a low success rate of 29.72%.

Qualitative analysis

The results of the Shape Cards Test show that all participating cases were able to easily perform symmetry correctly between the disks. Most of them relied on visual matching rather than finger-pointing, indicating a high level of control in performing this task. This control was also evident in the principle of stable order, as most participants were able to recite a fixed numerical sequence and count up to 21, except for four cases who did not respect the correct sequence of numbers.

With regard to the cardinality principle, 25 participants understood that the last number uttered represents the total number of objects counted. However, 12 participants were unable to grasp this principle, as they would restart counting to provide an answer. It is worth noting that these 12 cases belonged to the youngest age group in the study (eight years old).

As for the fourth principle, the order irrelevance principle, it was understood by only a small number of participants. Meanwhile, 26 participants failed to recognize that the number of items in a set does not change when their order is altered. This led them to doubt their answers and recount the items from another direction, believing that starting the count from a different point would not yield the same number of disks.

Table 02: Success rates of participants in the comparison test

Test	First Transformation	Second Transformation	Third Transformation
Number of Cases	20	35	13
Percentages	54.05%	94.59%	35.13%

The findings in Table 2 show clear differences in performance across the three transformations. The lowest success rate appeared in the third transformation, where only 35.13% of participants succeeded. This result was somewhat unexpected, given that the first transformation—a simpler version of the third—recorded a higher success rate of 54.05%. In contrast, the second transformation yielded the strongest performance, with nearly all participants (94.59%) completing it successfully.

Qualitative analysis

The Comparison Test results suggest that children performed moderately well when comparing small groups (e.g., two versus five cubes). However, when asked to compare larger groups (10 versus 12 cubes), many struggled to identify differences. Their answers were often hesitant, inconsistent, and based more on visual impressions than on actual counting.

Some children limited their responses to general statements such as “this is fewer” or simply restated the numbers (e.g., “this group has 10 cubes and this one has 12”) without explicitly using comparison terms like *more than* or *less than*.

In the second transformation, performance was much stronger. Most children had no difficulty identifying equality between groups, whether by visual judgment or finger counting. Only two participants failed to use comparison expressions; instead, they counted each group separately but did not apply the counting outcome to make a comparison.

Table 03: Success rates of participants in the practical use of number test

Test	Practical Use of Number
Number of Cases	27
Percentages	72.97%

In problem-solving tasks involving the practical use of numbers, participants showed relatively strong performance, with a success rate reaching 72.97%.

Qualitative analysis

Most children completed the task with ease. However, ten participants initially gave approximate answers, struggling to apply the strategy of matching the number of dolls with the number of dresses. Their main difficulty lay in failing to visualize the reference group. Instead, they brought all the dresses at once and placed them over the dolls.

Once the instructions were clarified, these participants quickly adjusted and applied the correct matching strategy, which shows that their challenge was not conceptual but procedural.

Table 04: Success rates of participants in the quantitative reasoning test

Test	Correspondence	Incomplete Groups
Number of Cases	35	30
Percentages	94.59%	81.08%

The results of the Quantitative Reasoning test indicate strong performance overall, with success rates of 94.59% for the correspondence task and 81.08% for the incomplete groups task.

Qualitative analysis

Most children demonstrated a solid grasp of the correspondence principle, easily matching elements between two groups and following the instructions without difficulty. Interestingly, two participants carried out the matching correctly but were unable to explain how they reached their answers, suggesting reliance on intuition rather than explicit reasoning.

For the Incomplete Groups task, most participants responded correctly, with some even noticing missing elements before being prompted. They often used visual cues or gestures to indicate the missing items, asking questions such as, *“Where did the carrots go?”*

Among the seven participants who provided approximate responses, difficulties arose when items were removed from two different places within a group. These children often required direct prompts and produced vague responses, such as, *“There are many tomatoes.”* Others gave correct answers but either took considerable time or failed to justify their reasoning clearly.

6.2. Interpretation of the results

The “Use of Number” test from the UDN-II battery (Meljac & Lemmel) was administered to 37 children aged between 8 and 11 years. The findings highlighted noticeable difficulties in tasks involving comparison. Many children struggled, particularly because they did not use counting as a strategy to compare groups. This aligns with Roditi (2005), who pointed out that for small groups, counting is not always necessary, as children can rely on visual perception. However, when it comes to larger quantities—beyond five—visual perception alone is not sufficient, as our ability to estimate numbers without counting is limited.

Another striking observation was the children’s limited use of comparison vocabulary. Terms such as *“more than”* or *“less than”* were often absent,

especially in tasks involving larger groups. Instead, their reasoning was largely guided by intuition and visual cues, and they often confused the concepts of “more” and “a lot.” This difficulty also reflects a lack of understanding that “more” (in Arabic: “أكثر”) expresses a non-symmetrical relationship. Such results are consistent with Melegac (1999), who noted that acquiring this vocabulary is typically delayed, as it depends on the development of logical-mathematical reasoning and usually becomes more stable after the age of 12.

When considering Gelman’s Four Principles of Counting, the children showed uneven performance in mastering and applying them together. This variation can be explained by the fact that these principles do not emerge at the same time, but rather in a developmental sequence. Amoura (2022), in her work on “Number Construction,” confirmed Gelman’s proposed order: first, the principle of one-to-one correspondence, followed by stable order, then the cardinal principle, and finally the order-irrelevance principle, which emerges later. This developmental sequence also underlies the design of Melegac’s test.

Among these, the greatest challenge was the principle of order-irrelevance. Many children gave spontaneous or incorrect answers, which can be explained by limited cognitive maturity. Gelman emphasized that these principles depend not only on biological development but also on cultural influences. Mastery of order-irrelevance, in particular, is linked to the ability to perceive quantities as wholes. Children who succeeded in small-set tasks tended to rely on memory of organized visual patterns, allowing them to understand that number remains constant regardless of the order in which objects are counted. This finding resonates with Fayol’s claim that mastery of this principle is often delayed and tied to the gradual development of visual perception as children grow.

In summary, the results indicate that children aged 8–11 experience varying levels of difficulty in applying number concepts. The most significant challenges arose with the order-irrelevance principle, followed by comparing large groups. By contrast, children showed relative ease in mastering the remaining counting principles, in applying numbers to practical problem-solving situations (e.g., the “dolls and dresses” task), and in quantitative reasoning.

Finally, beyond developmental and cognitive factors, these difficulties may also reflect the impact of teaching methods and curricula in schools, as well as delayed acquisition of these skills among Algerian children. This is consistent with Zerroug (2008–2009), who found that Algerian children—both hearing and deaf—lagged behind their peers in European studies when it came to

understanding the concept of conservation. She attributed this gap to slower cognitive development in Algerian children compared to their European counterparts.

Overall, the study highlights both the areas where children between 8 and 11 face significant challenges in using numbers, and the areas where they demonstrate stronger skills and relative ease.

Conclusion:

In light of this research, and based on the empirical data and results obtained, the present study represents a serious scientific attempt to identify the difficulties children face in their use of numbers, and to pinpoint the specific levels at which these difficulties become apparent.

Our investigation focused on children's use of numbers in relation to Gelman's four principles—namely, the principle of one-to-one correspondence, the principle of stable order, the cardinal principle, and the principle of order irrelevance. In addition, we examined the use of numbers in comparison tasks, problem-solving situations (the practical application of numbers), and quantitative reasoning.

The findings revealed the presence of difficulties in children's use of numbers, varying in degree across the target group. These difficulties were manifested in some areas as markedly challenging, while in others they appeared with relative ease.

Finally, it should be emphasized that the results obtained in this study are relative and cannot be generalized, as they remain specific to the study sample, within the temporal, spatial, and performance-related boundaries of the research. Accordingly, it can be concluded that the field of scientific inquiry continues to require further studies and research that address this topic more deeply and from different perspectives.

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