Recibido: Ene. 20, 2021 | **Aceptado:** May. 15, 2021

Research Article

Development of numerical thinking through didactic sequence in educational escuela nueva for second grade

Desarrollo del pensamiento numérico mediante secuencia didáctica en modelo educativo escuela nueva para grado segundo

Desenvolvimento do pensamento numérico através de uma seqüência didática na segunda série novo modelo educacional escolar para a segunda série.

DOI: https://doi.org/10.21803/penamer.14.28.377

Sandra Macerla Pitre Alarcón
https://orcid.org/0000-0003-3511-3569
Magister en didáctica de la Matemática, Especialista en Didáctica de la Matemática para la Educación Básica, Licenciado en Educación básica con énfasis en Matemáticas, Humanidades y Lengua Castellana, Universidad Pedagógica y Tecnológica de Colombia. Docente Preescolar y Primaria Institución Educativa Municipal Guavio Bajo de Fusagasugá. sandramarcelapi_13@hotmail.com

José Eriberto Cifuentes Medina
https://orcid.org/0000-0001-5702-620X.
Investigador Asociado (I) SNCTeI, convocatoria 833. Estudiante de Doctorado en Educación, Universidad Santo Tomás Cohorte XII. Magister en Educación, Especialista en Evaluación Educativa, Licenciado en Teología, Licenciado en Filosofía y Educación Religiosa, Universidad Santo Tomás. Especialista en Pedagogía y Docencia, Licenciado en Ciencias Sociales; Fundación Universitaria del Área Andina. Docente – Investigador Escuela de Ciencias Humanísticas y Educación – Facultad de Estudios a Distancia, Universidad Pedagógica y Tecnológica de Colombia. joseeriberto.cifuentes@uptc.edu.co

¿Cómo citar este artículo?
Pitre, S. & Cifuentes, J. (2021). Desarrollo del pensamiento numerico mediante secuencia didactica en modelo educativo escuela nueva para grado segundo. *Pensamiento Americano, 14*(28), 29-48. DOI: https://doi.org/10.21803/penamer.14.28.377

Abstract

Introduction: The article aims to demonstrate the use of a didactic sequence in the Escuela Nueva model, which due to its integrating characteristics must be present at various times in the process of developing numerical thinking. **Objective:** To analyze the effects evidenced by the implementation of the didactic sequence in the Escuela Nueva model, in the development of numerical thinking in second grade students. **Methodology**: Mixed research, in the line of research: development of mathematical thinking. It was carried out with students from the second grade of primary school, between 7 and 9 years old, from the Guavio de Fusagasugá Municipal Educational Institution. **Results:** To achieve this goal, a pedagogical proposal was designed and applied, which consisted of a didactic sequence that contains three sessions, where cooperative work is used, the game as a motivating agent, the use of didactic material that in turn is conducive to the students activities such as counting, numbering, relating, comparing, performing mental calculations as well as the use of addition and subtraction operations, which offered opportunities to enhance students' numerical thinking. **Conclusions:** Continuous and effective commitment was demonstrated, which allows to initiate a process of methodological and didactic change in the teaching and learning process in the area of mathematics, taking advantage of and adapting all the resources of the institution and the community, such as: physical spaces, didactic material. and development of a playful pedagogy that allowed the interaction of students and teachers for the development of numerical thinking, demonstrating that through a didactic sequence, students build knowledge, make numerical relationships and learn significantly.

Key words: Didactic sequence, New School, Numerical thinking

Resumen

Introducción: El artículo tiene como finalidad demostrar el aprovechamiento de una secuencia didáctica en el modelo Escuela Nueva, que por sus características integradoras debe estar presente en diversos momentos del proceso de desarrollo del pensamiento numérico. **Objetivo:** Analizar los efectos que evidencia la implementación de la secuencia didáctica en el modelo Escuela Nueva, en el desarrollo del pensamiento numérico de los estudiantes de grado segundo. **Metodología:** Investigación mixta, en la línea de investigación: desarrollo del pensamiento matemático. Se realizó con estudiantes del grado segundo de primaria, entre los 7 y 9 años, de la Institución Educativa Municipal Guavio de Fusagasugá. **Resultados:** Para lograr esta meta se diseñó y aplicó una propuesta pedagógica la cual consistió en una secuencia didáctica que encierra tres sesiones, donde se emplea el trabajo cooperativo, el juego como agente motivador, la utilización de material didáctico que a su vez propicio en los estudiantes actividades como contar, numerar, relacionar, comparar, realizar cálculos mentales además el empleo operaciones de adición y sustracción, lo cual ofreció oportunidades de potencialización del pensamiento numérico de los estudiantes. **Conclusiones:** Se demostró compromiso continuo y eficaz, que permite iniciar un proceso de cambio metodológico y didáctico en el proceso enseñanza y aprendizaje en el área de matemáticas aprovechando y adaptando todos los recursos de la institución y la comunidad como son: espacios físicos, material didáctico y desarrollo de una pedagogía lúdica que permitió la interacción de estudiantes y docente para el desarrollo del pensamiento numérico, demostrando que a través de una secuencia didáctica los estudiantes construyen conocimientos, hacen relaciones numéricas y aprenden significativamente.

Palabras Clave: Secuencia didáctica, Escuela Nueva, Pensamiento numérico.

Resumo

Introdução: O artigo visa demonstrar o uso de uma seqüência didática no modelo Escuela Nueva, que devido às suas características integradoras deve estar presente em vários momentos do processo de desenvolvimento do pensamento numérico. Objetivo: Analisar os efeitos da implementação da seqüência didática no modelo Escola novo sobre o desenvolvimento do pensamento numérico nos alunos da segunda série. **Metodologia:** Pesquisa mista, na linha da pesquisa: desenvolvimento do pensamento matemático. Foi realizado com alunos da segunda série do ensino fundamental, entre 7 e 9 anos de idade, da Instituição Municipal de Educação Guavio, em Fusagasugá. **Resultados:** Para atingir este objetivo foi elaborada e aplicada uma proposta pedagógica que consistia em uma seqüência didática que engloba três sessões, onde se utiliza o trabalho cooperativo, o jogo como agente motivador, o uso de material didático que, por sua vez, propiciou nas atividades dos estudantes atividades como contar, numerar, relacionar, comparar, fazer cálculos mentais além do uso de operações de adição e subtração, o que ofereceu oportunidades para a potencialização do pensamento numérico dos estudantes. **Conclusões:** O compromisso contínuo e efetivo foi demonstrado, o que permite iniciar um processo de mudança metodológica e didática no processo de ensino e aprendizagem na área da matemática, aproveitando e adaptando todos os recursos da instituição e da comunidade, tais como: espaços físicos, materiais didáticos e recursos comunitários e o desenvolvimento de uma pedagogia lúdica que permitisse a interação de estudantes e professores o desenvolvimento do pensamento numérico, demonstrando que, através do uso de uma seqüência didática, os estudantes constroem conhecimentos, fazem relações numéricas e aprendem significativamente.

Palavras-chave: Seqüência de ensino, Escuela Nueva, Pensamento numérico.

Introduction

The research refers to a study on the change generated by the implementation of didactic sequences in the subject of mathematics, taking into account the educational model "Es- cuela nueva", as a pedagogical proposal based on experiential learning and classroom practices that contribute to the development of numerical thinking through two of the basic operations addition and subtraction, the research study will be conducted with students in the second grade of primary school, aged 7 to 9 years old, from the educational institution Guavio Bajo in the municipality of Fusagasugá.

At the national level, the Ministry of National Education, starting in 1998 with the curricular guidelines in mathematics and later with the publication of the standards in the same area, gave a space to numerical thinking within the teaching and learning of mathematics in our country. Because of this, we can consider within mathematical intelligence the development of numerical thinking, since it frames the use of numbers in different situations, in the words of Obando and Vásquez (1998):

> ...numerical thinking refers to a person's overall understanding of numbers and operations along with the ability and inclination to use this understanding in flexible ways to make mathematical judgments and to develop useful strategies for handling numbers and operations" (p. 17).

All human beings from an early age and throughout our lives are immersed in activities that involve numbers, but if so, why is there difficulty in developing this thinking?

A detailed analysis of the results of the results of the mathematics tests for 3rd grade applied in 2016 and 2017, in our institution, shows us a reality, a notorious difficulty in five specific learning processes pertaining to numerical thinking, which are: recognizing equivalences between different types of representations related to numbers, recognizing the use of natural numbers in different contexts, solving and formulating simple problems, using operations and properties of natural numbers to establish relationships between them in specific situations and generating equivalences between numerical expressions.

The research assumes that the general understanding that students must develop about numbers and the operations that are carried out (addition and subtraction), together with the ability to make mathematical judgments, needs the creativity, innovation and updating of the teacher to seek didactic strategies that facilitate this process. Considering that the context through which students approach mathematics is a determining aspect for the development of numerical thinking, it is important to provide rich and meaningful situations, through didactic environments that facilitate this mathematical process. And it is intended that through the creation and implementation of a didactic sequence that second grade students generate and strengthen attitudes and skills of numerical type, which allow them to be mathematically competent individuals. In addressing the concept of didactic sequence can be considered:

Didactic strategies are defined as the procedures (methods, techniques, activities) by which the teacher and the students consciously organize actions to build and achieve foreseen and unforeseen goals in the teaching and learning process, adapting to the needs of the students.

The participants' abilities in a meaningful way (Feo, 2020, p.22).

According to this approach, it can be inferred that didactic sequences are a plan of action and interaction that contribute to the construction of knowledge in a relevant way. For the construction of these sequences, the MEN (2013) establishes some necessary guidelines such as: general vision, learning path, learning description and evaluation instrument.

This type of strategy adapts very well to our needs and context, because as mentioned above there are certain difficulties in learning some numerical knowledge which need a didactic resignification by the teacher, besides being a rural educational institution, multigrade which makes us part of the Escuela Nueva model, which is defined by the MEN as: "School-based model of formal education, with answers to the rural multi-grade and the heterogeneity of ages and cultural backgrounds of students in urban-rural schools".

For this reason, the current research focuses on the mathematical needs (numerical thinking) of our context, suggesting a series of activities to be developed within a didactic sequence which aims to strengthen the mathematical educational process in the Escuela Nueva model. The methodology used in this research is participatory action since:

> The qualitative approach presents particular characteristics that distinguish it from other options under the qualitative approach; among them we can point out the way in which the object of study is approached, the intentions or purposes, the actions of the social actors involved in the research, the different procedures developed and the achievements attained (Colmenares, 2012, p. 105).

In this way, this methodology allows us to identify and have a direct approach with the actors object of the research, in this case the second grade students of the I.E.M. Guavio Bajo, capturing perceptions, points of view, attitudes and behaviors about the didactic sequence applied.

II. THEORETICAL FOUNDATION

To address the subject of this research, it is necessary to work from the following theoretical perspectives: numerical thinking, didactic sequences and Escuela Nueva, problem situations, problem solving that integrate addition and subtraction, didactics of mathematics in the teaching and learning of addition and subtraction, analysis of tests to know 2016 and 2017. This section presents the theoretical references that support the problem posed, this foundation has been divided into four components which are: Mathematical thinking, New school, Didactic sequences and Problem solving.

The existing relationship between daily activities that involve actions with numbers is significant, which is why it is important to create solid foundations from the early years and strengthen them through the educational progression that is generated throughout school life, such processes are due to the successful development of appropriate pedagogical practices capable of generating links between student-learning-teacher.

Numerical Thinking

From an early age, all human beings are involved in daily activities that include the use of numbers, from very simple actions such as looking at the clock and thus knowing the time, we are already performing numerical calculations, the use of money, counting objects, comparing quantities, in short, there are countless actions that we perform daily with these, and thus the application of operations, Therefore, in 2003 the Ministry of National Education (MEN) published the Basic Mathematics Standards, providing continuity to what was disclosed in the Curricular Guidelines released in 1998, in which five thoughts are proposed and one of them focuses on the way of studying numbers, known as numerical thinking, which is taken from Obando and Vásquez (1998);

It refers to a person's overall understanding of numbers and operations along with the ability and inclination to use this understanding in flexible ways to make mathematical judgments and to develop useful strategies for handling numbers and operations. (Mcintosh, 1992).

In this sense, it is valid to indicate that numerical thinking is conceived as a competence or ability with respect to situations that require some type of application of numbers. Within the curricular guidelines mentioned above, it refers that numerical thinking is "acquired gradually and evolves as students have the opportunity to think about numbers and to use them in meaningful contexts, and it manifests itself in different ways according to the development of mathematical thinking" (Obando and Vásquez, 1998, p. 26). It is true that we are all immersed in the use of numbers in different daily situations, but it is also a reality that this thinking must progress gradually. Pedagogical practice can support the strengthening of this thinking by creating pleasant and meaningful didactic situations for the student. Piaget and Szeminska (1975) asserted that the development of numerical thinking occurs through activities such as counting and the word-number relationship, all linked to information processing.

It is assumed that the general understanding that students should develop about numbers and operations (specifically addition and subtraction), together with the ability to make mathematical judgments, requires the teacher's creativity in seeking didactic strategies that foster this process. Considering that the context through which students approach mathematics is a determining aspect for the development of numerical thinking, it is important to provide rich and meaningful situations through didactic environments that facilitate this mathematical process.

New School

Escuela Nueva is an educational model aimed mainly at multi-grade schools in rural areas, characterized by the high dispersion of their population; for this reason, in these educational centers, children in three or more grades have only one teacher to guide their learning process;

This educational model emerged in Colombia approximately 35 years ago. Since then, it has been enriched by teams of educators who have integrated the theoretical proposals of active pedagogy with lessons learned from their experiences and classroom practices. Various documents and materials with information on the conceptual and historical bases and evaluation results are widely circulated among primary school educators (MEN, 2010, p.5).

The Escuela Nueva as a methodology that offers us a change in the classroom, which invites us to carry out a systematic transformation of learning adaptability to the environment where the student develops. The educational needs in the rural context are very varied and the situations that arise every day imply a series of educational challenges which we teachers must assume with relevance and commitment. In our Institution we encounter students day by day who present diverse situations such as extra age, intellectual disabilities, repotency, nutritional problems, family dysfunction, floating population, among others that make us think of a necessary methodological restructuring.

Didactic Sequences

Didactic sequences are pedagogical tools for the teacher, which propose a series of instructions and activities that can be applied jointly by student-teacher-teacher, in order to generate environments conducive to learning. Rubio, Marín and Ruiz (2009) consider didactic sequences as "the series of activities that, articulated together in a didactic situation, develop the student's competence. They are characterized because they have a beginning and an end, they are antecedents with consequents" (p. 11). From this point of view, we can affirm that didactic sequences must have a reasonable continuity, that is, each activity must be connected with the previous and the following one, all of which are absorbed in the central problem situation.

For the Ministry of National Education "The didactic sequences are an exercise and a possible method proposed to the teacher interested in exploring new ways of teaching mathematics" (2013, p. 9), to which we can say that the didactic sequences in mathematics are a pedagogical structure focused on an innovative design to guide mathematics to our students.

A didactic sequence should be composed of a series of activities that, as mentioned above, should have a succession of actions that link situations of the context, in addition to problematic circumstances, thus generating meaningful environments in the teaching and learning process, and that also allows linking the previous knowledge that the student already has and clear information about where the new knowledge is intended to reach. Díaz (2019) in his research suggests;

The line of didactic sequences is integrated by three types of activities: opening, development and closing. In the conformation of this proposal of activities simultaneously underlies a formative evaluation perspective (Scallon, 1988), which allows feedback on the process through the observation of the progress, challenges and difficulties presented by the students in their work, as well as a summative evaluation, which offers evidence of learning, in the same path of learning (p.5).

This suggests that the activities implicit in a didactic sequence, in addition to being logically ordered, should have a pedagogical purpose. The opening activities can be described as the starting moment, where the teacher has the opportunity to make the students expose their previous knowledge and create an environment conducive to the teaching and learning process. This activity depends on the autonomy of the teacher, i.e., it can be individual or group, it can be carried out inside or outside the classroom, it can involve any didactic material, among other criteria. As for the development activity, it is the one whose main objective is for students to correlate with the new knowledge. The closing activity has two objectives: the first is to culminate the process and the second is to evaluate the results obtained from the succession of activities.

Troubleshooting

With respect to mathematics education the problem-solving method is a productive strategy in terms of the development of numerical thinking. "The importance of problem solving is internationally recognized as a central aspect of the learning process in mathematics and continues to be the main concern of educators and researchers in mathematics education" (Díaz and Poblete, 2009). The importance of problem solving in the student must necessarily test certain competencies such as understanding, analyzing, reflecting, using strategies, generalizing, etc. At the same time, they provide the opportunity to make conclusions, to experiment, to verify, to learn from mistakes, among others, which is why this type of activities related to problem solving is a good way to make our students reflect on the importance of thinking about what is done and how it is done. Taking into account the importance of problem solving as a valuable tool in the development of mathematical skills (in this particular case the development of numerical thinking), its approaches is not something that we teachers should take lightly, much less make this activity a copy of texts and more texts, this is an action that deserves special attention as it is a process that necessarily involves students and teachers.

As Santos (2007) mentions:

> It identifies problem solving as a way of thinking where a learning community (students and teacher) look for different ways to solve the situation and recognize the relevance of justifying their answers with different types of arguments. That is, the goal is not only to report an answer but to identify and contrast different ways of representing, exploring and solving the problem. It also contemplates activities to extend the initial problem and formulate conjectures and other problems. (p.4)

It is a reality that students feel a certain level of apathy with the resolution of mathematical problems because they find it difficult to solve them, also because for them it does not have a meaning, much less a reality, so we can start from there, making their planning appealing, showing them a possible situation of their daily life, and also that they have the necessary knowledge to be able to provide a solution, However, it is necessary to take into account the diversity in the learning rhythms and the diverse abilities that each one of the students possess, which makes this process very heterogeneous, and considering that sometimes the result is not important but the process to reach it, without leaving aside the significance of creating an environment where the student feels confident in their approaches and that from the error they can learn and improve. In this way, students will be able to increase their skills every time they solve this type of situation, gradually acquiring the proposed competencies.

In addition to problem solving as a tool for the development and strengthening of mathematical competencies, there are other situations that also contribute to the progress of the aforementioned skills. It is worth highlighting the amount of time that students spend in the classroom, specifically around 5 to 7 hours per week that correspond to the area of mathematics depending on the curriculum of each educational institution (interdisciplinarity among other areas is not mentioned). These spaces should be converted into didactic situations that invite the student to

But what kind of situations can I foster as a teacher to develop mathematical competencies in my students? It should be noted that our au- thorities are made up of students with different learning styles and rhythms, where the same strategy will not always work, but we can resort to games, cooperative work, the use of ICT, among others that make students move away from traditionally transmitted educational formalisms (notebook-board). In D'Amore's terms, "mathematical knowledge is the product of the elaboration of the experience with which the learner comes into contact" (2008, p. 27).

George Polya is one of the most brilliant mathematical researchers of our time, and despite the years his theories are still valid. One of his most outstanding works is the extensive research designed to provide solutions to problematic situations.

Despite the years that have passed since the creation of the method proposed by Pólya, it is still considered today as a highly interesting reference for problem solving. The four phases that make up the programming cycle are consistent with the steps described by Pólya to solve mathematical problems (López, 2004, p.6).

III. OBJECTIVES

To identify the effects generated by the design of a didactic sequence in the Es- cuela Nueva educational model in the development of numerical thinking through addition and subtraction of second grade students of the Institución Educativa Municipal Guavio of the municipality of Fusagasugá.

To diagnose knowledge related to numerical thinking in second grade students of the Guavio Bajo Municipal Educational Institution.

To organize a didactic sequence that stimulates the development of numerical thinking through two of the basic operations (addition and subtraction).

To record the results produced by the application of the didactic sequence as a pedagogical strategy for the development of numerical thinking within the Escuela Nueva educational model.

IV. METHODOLOGY

The research presents several stages, the purpose of which is to identify the effects of a didactic sequence. The research is located within the type of mixed research, which allows quantitative and qualitative analysis, so that data can be collected and the results of the students' behaviors regarding the development of numerical thinking can be organized. This research uses the questionnaire and field diary instruments as a tool for the collection of pedagogical information. For Hernández, Fernández and Baptista (2014) "the goal of mixed research is not to replace quantitative research or qualitative research, but to use the strengths of both types of inquiry combining them trying to minimize their potential weaknesses." (p. 544).

This research proposal is based on the action research method. Action research

participatory or action research, which:

> It is a methodology that presents particular characteristics that distinguish it from other options under the qualitative approach; among them we can point out the way in which the object of study is approached, the intentions or purposes, the actions of the social actors involved in the research, the various procedures that are developed and the achievements that are reached (Colme- nares, 2012, p.4).

In 2003, by means of Decree 062 of the Municipal Secretary of Education, based on the provisions of Law 715 of December 21, 2001, the Guavio Bajo Municipal Educational Institution was created, consisting of ten (10) rural seats "Palacios, La Trinidad, Bochica, El Consuelo, San Ana, Batán, El Carmen, Santa Lucía, Guavio Alto and Guavio Bajo". Its technical modality is agricultural. In 2020, there are students enrolled in preschool, elementary and middle school, with ages ranging from 4 to 18 years old.

Table 1.
Population and Sample

	APPEARANCEBRIEF DESCRIPTION
POPULATION	I.E.M. Guavio bajo currently has 35 second grade students located in different locations.
SAMPLE	The reference sample for this research is 20% (7 students enrolled in the main campus of the Institution).
HYPOTHESIS	With the application of the didactic sequence, the second grade students of I.E.M. Guavio Bajo show significant progress in numerical thinking.
CONTEXT	They are rural students belonging to multigrade groups. Their family activities are agricultural and livestock activities which are alternated with academic activities on the part of the students.

Source: Own elaboration.

After conducting a careful analysis of the 2016 and 2017 saber tests in grade 3 in the area of mathematics, a problem concerning the numerical thinking of I.E.M. Guavio Bajo was evidenced, this research chooses to be divided into three phases of work, which are intertwined in order to achieve the general objective of the aforementioned work

Table 2.
Research phases

RESEARCH PHASESPECIFIC	OBJECTIVE	INSTRUMENT
FIRST PHASE Diagnostic test	To diagnose knowledge related to numerical thinking in second grade students of the Guavio Bajo Municipal Educational Institution.	Questionnaire
SECOND PHASE Application didactic sequence	To organize a didactic sequence that stimulates the development of numerical thinking through two of the basic operations (addition and subtraction).	Field diary
THIRD STAGE Daily field analysis	To record the results produced by the application of the didactic sequence as a pedagogical strategy for the development of numerical thinking within the Escuela Nueva educational model.	Field diary

Source: Own elaboration.

RESULTS AND DISCUSSION

The first technique for data collection used in this research is the questionnaire, which through its analysis gives us the starting point to understand the ability to solve situations regarding the development of numerical thinking of students, and also provides us with the necessary information for the construction and application of the second phase. Questionnaire: In this phase it is possible to show the following results.

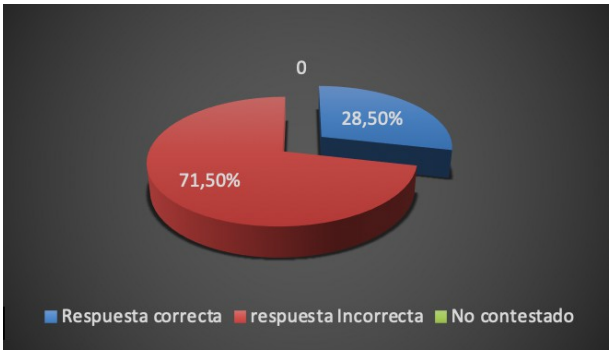
Table 3.
Diagnostic test

	Frequency	%
Correct answer	2	28,50%
Incorrect answer	5	71,50%
Not answered	0	0

Source: Own elaboration.

This table shows the type of answer given by the 7 students to whom the questionnaire was applied with respect to question 1, where 5 students answered incorrectly and 2 students answered correctly.

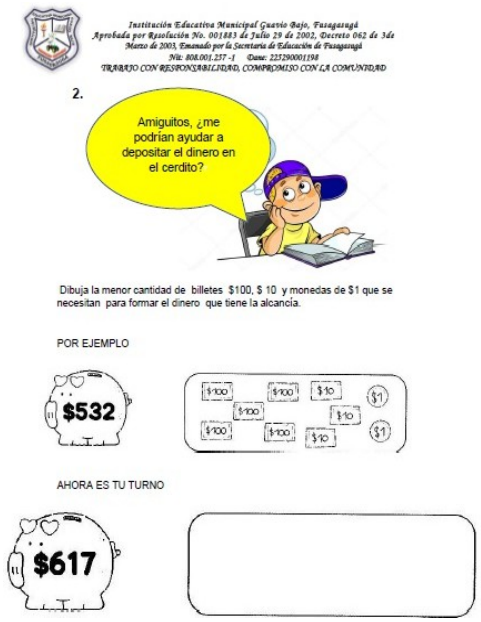
Figure 1.
Analysis of results question



Source: Own elaboration.

According to the data obtained on question number 1, we can affirm that 72% of the students to whom the questionnaire was applied answered incorrectly and 29% answered correctly. With this we can analyze that there is a considerable deficiency in the children of the second grade of the I.E.M Guavio Bajo with respect to the learning "To recognize equivalences between different types of representations related to numbers".

Figure 2.
Situation 2



Source: Own elaboration.

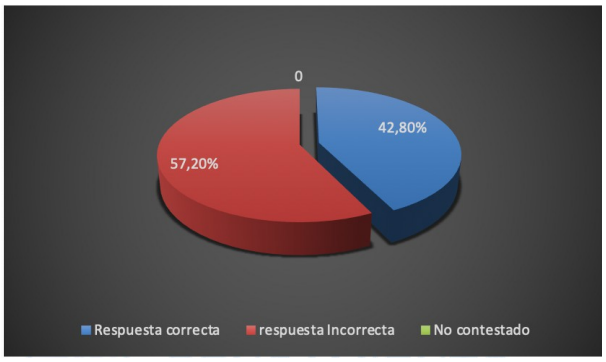
Table 4.
Diagnostic test

	Frequency	%
Correct answer	3	42,80%
Incorrect answer	4	57,20%
Not answered	0	0

Source: Own elaboration.

This table shows the type of answer given by the 7 students to whom the questionnaire was applied with respect to question 2, where 4 students answered incorrectly and 3 students answered correctly.

Figure 3.
Analysis of results question



Source: Own elaboration.

According to the data obtained on question number 2, we can affirm that 57.2% of the students to whom the questionnaire was applied answered incorrectly, with this we can analyze that more than half of the students find it difficult to learn "Recognize the use of natural numbers in different contexts" with respect to numerical thinking and that 42.8% were able to give a correct solution to the situation.

Figure 4.
Situation 3

Source: Own elaboration.

Table 5.
Diagnostic test

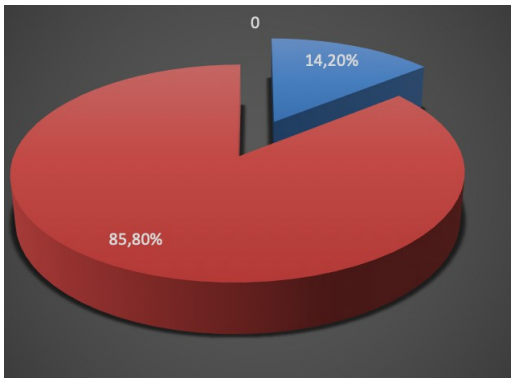
	Frequency	%
Correct answer	1	14,20%
Incorrect answer	6	85,80%
Not answered	0	0

Source: Own elaboration.

This table shows the type of answer given by the 7 students to whom the questionnaire was applied with respect to QUESTION 3, where 6 students answered incorrectly and one student answered correctly.

According to the data obtained on question number 3, we can affirm that only 14% of the students to whom the questionnaire was applied answered the questionnaire correctly, whereas

Figure 5.
Analysis of results question 3



Source: Own elaboration.

Figure 6.
Situation 3

Source: Own elaboration.

Table 6.
Diagnostic test

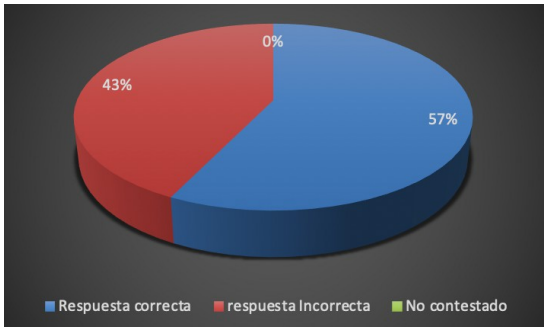
	Frequency	%
Correct answer	4	57,20%
Incorrect answer	3	42,80%
Not answered	0	0

Source: Own elaboration.

The remaining percentage shows a low level in the learning "Solving and formulating simple problems" contained in numerical thinking.

This table shows the type of answer given by the 7 students to whom the questionnaire was applied with respect to question 4, where students answered incorrectly and 4 students answered correctly.

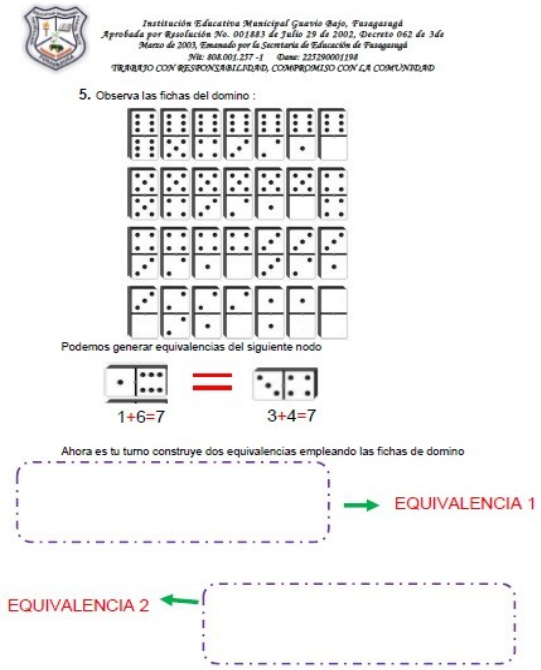
Figure 7.
Analysis of results question 4



Source: Own elaboration.

In this question we can see that more than half of the students, i.e. 57%, answered the situation correctly, while 42.8% of the students answered incorrectly, which leads us to conclude that there is a minor deficiency among the population in terms of learning "To use operations and properties of natural numbers to establish relationships between them in specific situations" contained in numerical thinking.

Figure 8.
Situation 5



Source: Own elaboration.

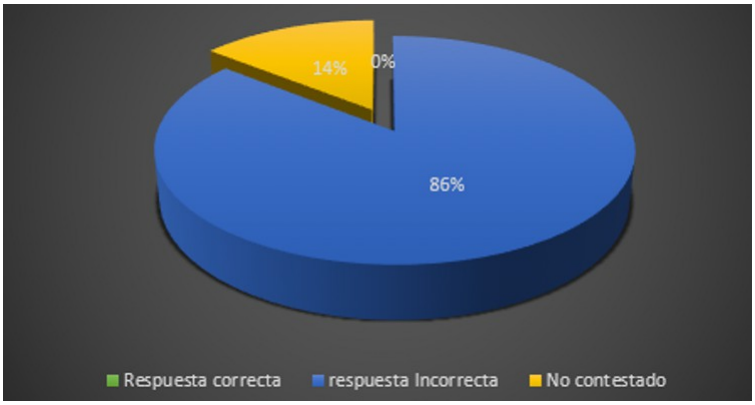
Table 7.
Diagnostic test

	Frequency	%
Correct answer	0	0,00%
Incorrect answer	6	85,20%
Not answered	1	14,20%

Source: Own elaboration.

This table shows the type of answer given by the 7 students to whom the questionnaire was applied with respect to question number 5, where 6 students answered incorrectly and one student did not answer.

Figure 9.
Analysis of results question 5



Source: Own elaboration.

According to the data obtained we can say that this question does not present any correct answer, 86% of the students who participated in the study answered incorrectly and 14% did not answer, these results show a significant difficulty in terms of learning "Generate equivalences between numerical expressions" present in numerical thinking.

APPLICATION OF DIDACTIC SEQUENCE AND FIELD DIARY ANALYSIS PHASE

The second and third phases of this research will be carried out jointly, where we will be able to visualize the field diaries and their respective analysis, which will provide us with clear information on the observations made during the application of the didactic sequence.

Field Diary

In this study, three field diaries were kept, each one reflecting a work session, where each session reflects three activities (opening, development and closing). The second phase is described in the box labeled "description" and the third phase, which corresponds to the analysis of the field diary, is called "considerations".

OPENING ACTIVITY

Table 8.
Field diary format

ASPECTS	DESCRIPTION	CONSIDERATIONS
Development of the activity carried out.	The teacher gives an explanation of the activity to be carried out. The classroom pacts that must be taken into account for its execution were exposed. After this introduction, the roles were assigned by means of a lottery, which consisted of each student rolling two didactic dice, which assigned them a number, which was reflected in an envelope with a role and an amount of money. The students then took their places at a table and opened their envelopes, and discovered the amount of money assigned to them. Each one explained the role he/she was supposed to play and what he/she liked about it. They were then asked to mentally count the amount of money they each had. Then they were given a work guide where the students had to draw a picture of the role they were to play, write down the amount of bills they had and total them. In this way, they were able to show their classmates the amount of money they each had.	• Difficulty is evidenced at the moment of counting money by performing mental calculations. • The students made several counts of the bills by making a mental calculation and most of them gave a different amount with each count. • With the help of the didactic guide, the students were able to know the exact amount of money they had because they were able to add up the bills they each had. • After each student's presentation of the amount of money each one had, they began to make numerical comparisons, such as I have more..., I have less..., you have less than..., etc.
Teacher-student communication	Classroom agreements were established from the beginning of the activity. Each activity was explained in advance of its execution. Clear language was used in the explanations. Students were able to spontaneously express questions, doubts and points of view.	Taking into account that it is a multigrade classroom, where in addition to the second grade students there were also first grade and preschool students who also participated in the activity, the teacher gave instructions to the other grades that would serve as observers of the activity.
Student performance	Students followed classroom covenants, in general they were The participants were receptive to the activities and carried them out in their entirety.	Some students were anxious at the beginning of the activity. Some students were also frustrated by the difficulty of mental counting.
Individual work and out-worked.	In spite of being located at a round table, the work in- The individual and group work was carried out and it should be noted that the individual and group work was respected.	The students in general behaved appropriately. In general, the group behaved appropriately and a sense of cooperativism (wanting to help their peers) was visualized.
Group work	The students shared with their peers, there was a permanent communication with them and expectations to listen to them.	There were some situations where students did not carry their school supplies such as pencils, erasers, pencils, crayons, colors, etc.
Use of materials bills, etc.).	Each student had his or her own materials (envelopes, and guides)	

Source: Own elaboration.

Field diary analysis phase field diary field diary no. 1 opening activity: this strategy allowed the students to apply mental calculations, which reflected a certain level of difficulty. Although they were initially frustrated by the impossibility of performing such calculations in an agile manner, this decreased when cooperation among them began. It is important to emphasize the importance of each student manipulating his or her own material, which made it easier for them to find solutions to the situations posed. Personally, I think that the most important aspect of this strategy was to establish links of help among students and their creativity to use numerical skills (counting was carried out in

DEVELOPMENT ACTIVITY

Table 9.
Field diary format

ASPECTS	DESCRIPTION	CONSIDERATIONS
Activity development	Again, each student rolled the dice, which The sum of their scores was assigned another envelope where the action to be taken was determined, i.e. whether to pay, buy, invest or win (each student had a different situation from the others). Afterwards, they were given a few minutes to find the possible solution, then they wrote it down in the guide and made a presentation to the group. Then corrections were made, points of view were taken, if they shared the way to solve and the result that was reached, it is worth mentioning that these corrections were tried to be made collectively. Afterwards, the students again carried out activities to compare the money they had with the money they started with.	There was a notable difficulty in terms of the operations to be carried out depending on the situation. It was evident the protagonism of some students in the correction of some situations of others, which generated frustration. It also appeared that some students did not know how to solve the situation and could not move forward until a precise explanation was given.
Teacher-student communication	Each activity was explained in advance of its execution. Clear language was used in the explanations, and students constantly expressed their concerns.	Students sometimes did not respect their classmates' turn to speak, which caused some situations where communication and feedback had to be repeated a couple of times.
Student performance	Students followed classroom covenants, even though they pre some situations were identified that merited a type of verbal recommendation	The students were a little more dissatisfied compared to the previous activity, since they were given a little more freedom in the execution of the activity and sometimes the didactic b- llets functioned as distracters.
Individual work	The students completed the activity.	The activity was successfully completed, although It should be noted that some took longer than others, that some needed more help than others.
Group work	Students necessarily had to share with their peers in the execution of the activity (in the resolution of problem situations and the exchange of bills).	Some students were unhappy with the need to hand out bills to their classmates as part of the activity. This situation was handled by the teacher, who said that the bills at the end of the activity would be distributed equally and that this was an activity to learn more.
Use of materials	Each student had his or her own materials (envelopes, bills, etc.). and guides)	The situation that arose due to the lack of supplies was overcome through the loan of these materials by colleagues and the teacher.

Source: Own elaboration.

This strategy served as one of the first contacts with problem solving, which generated a certain level of difficulty, since some students still do not have clarity regarding the type of operation that should be used to solve problem situations, it is worth highlighting the importance of the fact that mistakes bring learning, in this case the students discovered some strategies that helped them.

CLOSING AND EVALUATION ACTIVITY

Table 10.
Field diary format

ASPECTS	DESCRIPTION	CONSIDERATIONS
Development of the activity In this activity, students will again interact with each other.	With their result, they were again assigned a different problem situation to each one, which was adapted to the role they were playing, and this problem was captured and solved in the didactic guide. They were given the necessary time for its solution (approximately 60 minutes), after which each student presented the way in which he/she solved it, and with that came the necessary corrections or suggestions as a group. After the presentations, the teacher gave each student an extra bonus for their performance in the activity. Subsequently, the students counted the bonus, made the total count of the money and with it the elaboration of the conclusions, that is, they determined the amount of money they finally obtained with the development of the activity, how much they earned, how much they lost, what is their difference in relation to the amount given at the beginning, questions that are contained in the didactic guide. They presented their performance in the activity, how they felt and finally the amount of money they ended up with.	Given the characteristics of this activity, which were similar to the previous one, it was possible to observe greater confidence and security at the time of its solution. The time used for its development was shorter compared to the previous activity, the level of motivation was clearly increased since the students had experience in the solution of problematic situations.
Teacher-student communication	As in previous activities, an explanation has been provided prior to the activity, questions have been asked during the process and suggestions have been accepted.	The feedback process is of vital importance for both the teacher and the students, since it provides judgment tools and arguments to validate solutions to numerical problems.
Student performance	Students were more attentive and motivated in the face of the activity	Work was carried out in a more homogeneous environment, students were more confident about the procedures to be used and more receptive to recommendations.
Individual work	Students completed the entire activity	The results of this activity were more satisfactory than those of the previous activity.tisfactors can be evidenced in the process and in the result.
Group work	Cooperation among peers is evident	Students were collaborative problems encountered by their colleagues in the solution of the activity.
Use of materials	Each student had his or her own materials (envelopes, and guides) bills, etc.).	The situation that arose due to the lack of supplies was overcome through the loan of these materials by colleagues and the teacher.
REMARKS	• Significant progress was noted in terms of the solution of numerical situations, with the progress of each of the activities, as evidenced in the work guides and the presentations made by the students. • The possibility that each student had the didactic material facilitated the experience of problem situations and thus the solution of the problems posed. • The mental calculations still show a difficulty, it is easier for him to translate the operations in order to give them a solution.	

Source: Own elaboration.

Field diary analysis phase: This strategy is the closing activity and therefore evaluative of this series of didactic activities, which is liked by the students due to the use of computers. Once again, it shows us the progress made by the students, who have shown that they are able to use computers.

The development of numerical activities has advanced considerably from being mechanical and rather complex to being accurate and mostly analyzed.

V. CONCLUSIONS

The research shows that through the proposed objectives it has been possible to identify the effects generated by the design of a didactic sequence in the Escuela Nueva educational model, in the development of numerical thinking through addition and subtraction of second grade students of the Guavio Municipal Educational Institution; considered as an important didactic strategy to enrich the teaching and learning processes of mathematics that also allowed the generation of new learning in students.

The difficulties presented by the second grade students were identified as a sample, where from the results of a diagnostic test it was possible to analyze the problems presented by them regarding numerical thinking, which reaffirmed weaknesses also pre-stated in the results of the 2016 and 2017 saber tests. The research highlights the significant progress in the teaching and learning process, with regard to the application of a didactic sequence within the Escuela Nueva Educational Model, which potentiates the development of numerical thinking in second grade students. Through the use of the didactic strategy, it demonstrated benefits for students in the construction of numerical competencies and skills.

Once the didactic sequence was applied with all its integrated strategies, the students advanced in an algorithmic progress towards the solution of problem situations that necessarily had to be solved with the use of numerical actions through playful, dynamic activities involving cooperative work. The students forged mathematical thinking through analysis, allowing us to affirm that the strategies used, in addition to favoring the student, also help the teacher to plan didactic environments that contribute to progress in learning and numerical skills. Each activity within the didactic sequence allowed the reciprocal action between student and teacher as well as student and student.

References

Colmenares, A. (2012). Investigacion-acción participativa: una metodología integradora del conocimiento y la acción. *Voces y silencios: Revista Latinoamericana, 3*(1), 102-115. https://revistas.uniandes.edu.co/doi/pdf/10.18175/vys3.1.2012.07

Díaz, A. (2019). Guía para la elaboración de una secuencia didáctica. Universidad Autónoma de México.http://www.setse.org.mx/ReformaEducativa/Rumbo%20a%20la%20Primera%20Evaluación/Factores%20de%20Evaluación/Práctica%20Profesional/Gu%C3%ADa-secuencias-didacticas_Angel%20D%C3%ADaz.pdf

Díaz, V. y Poblete, A. (2009). Competencias y transposición didáctica: Binomio para un efectivo perfeccionamiento en matemática. *Investigación y Postgrado, 24*(2), 77-107. http://ve.scielo.org/scielo.php?script=sci_arttext&pid=S1316-00872009000200005&lng=pt&tlng=es.

D'Amore B. (2008). Epistemología, didáctica de la matemática y prácticas de enseñanza. Enseñanza de la matemática. *Revista de la ASOVEMAT.17*(1), 87-106. http://www.dm.unibo.it/rsddm/it/articoli/damore/655%20Epistemologia%20didactica%20y%20practicas.pdf

Feo, R. (2015). Orientaciones básicas para el diseño de estrategias didácticas. *Tendencias Pedagógicas, 16.* 221-236. https://revistas.uam.es/tendenciaspedagogicas/article/view/1951

Hernández, R. Fernández, C. y Baptista, P. (2014). *Metodología de la investigación.* Sexta edición. http://observatorio.epacartagena.gov.co/wp-content/uploads/2017/08/metodologia-de-la-investigacion-sexta-edicion.compressed.pdf

López, L. (2004). Población muestra y muestreo. *Punto Cero,* 09(08), 69-74. http://www.scielo.org.bo/scielo.php?script=sci_arttext&pid=S1815-02762004000100012&lng=es&tlng=es

Ministerio De Educación Nacional (MEN). (2013). *Secuencias Didácticas en Matemáticas para Educación Básica Primaria.* https://www.mineducacion.gov.co/1759/articles-329722_archivo_pdf_matematicas_primaria.pdf

Ministerio De Educación Nacional (MEN). (2010). *Escuela Nueva, manual de impementación Escuela Nueva, Generalidades y orientaciones pedagógicas para transición y primer grado.* Tomo I. https://www.mineducacion.gov.co/1759/articles-340089_archivopdf_orientaciones_pedagogicas_tomoI.pdf

Obando, G. y Vásquez, N. (1998) *Pensamiento numérico del preescolar a la educación básica*. El encuentro colombiano de matemática educativa. http://funes.uniandes.edu.co/933/1/1Cursos.pdf

Piaget, J. y Szeminska, A. (1975). *Génesis del número en el niño.* 4ª ed. Editorial Guadalupe.

Rubio, A., Marín, L. y Ruiz, S. (2009) The Role of Identity Salience in the Effects of Corporate Social Responsibility on Consumer Behavior. *Journal of Business Ethics 84,* 65-78. doi: 10.1007/s10551-008-9673-8

Santos, M. (2007). Mathematical problem solving: an evolving research andpractice domain. *The International Journal on Mathematics Education, 39,* 523-536. https://www.researchgate.net/publication/226283729_Mathematical_problem_solving_An_evolving_research_and_practice_domain

2021, Vol. 14(28) 29-48. ©The Author(s) 2021
Reprints and permission: www.americana.edu.co
http://publicaciones.americana.edu.co/index.php/pensamientoamericano/index