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PROJECT PEDAGOGY AND NUMERICAL THINKING IN THIRD GRADE STUDENTS

PEDAGOGÍA DE PROYECTOS Y PENSAMIENTO NUMÉRICO EN ESTUDIANTES DE TERCER GRADO

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ABSTRACT.

The objective of this study was to implement an intervention proposal using the Pedagogy of Projects for the development of numerical thinking, aimed at students in the third grade of the COMFANORTE School, in the municipality of Los Patios, Norte de Santander department. From a methodological point of view, it is a quantitative study with a pre and posttest design of a control group. We worked with two variables: dependent related to the learning of numerical thinking and independent Project Pedagogy. The results show that the experimental group increased the scores of the posttest with respect to the pretest in the three dimensions: problem solving, communication and reasoning. The control did not have a significant variation of scores between pretest and posttest. It's observed that an intervention

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plan with Pedagogical Projects could contribute to the development of numerical thinking.

RESUMEN.

El presente estudio tuvo como objetivo implementar una propuesta de intervención utilizando la Pedagogía de Proyectos para el desarrollo del pensamiento numérico, dirigida a los estudiantes del tercer grado del Colegio COMFANORTE, del municipio de Los Patios, departamento de Norte de Santander. Desde el punto de vista metodológico, se trata de un estudio cuantitativo con un diseño pre y postest de grupo control. Se trabajó con dos variables: dependiente relacionada con el aprendizaje del pensamiento numérico e independiente Pedagogía del Proyecto. Los resultados muestran que el grupo experimental incrementó las puntuaciones del postest con respecto al pretest en las tres dimensiones: resolución de problemas, comunicación y razonamiento. El control no tuvo una variación significativa de puntajes entre el pretest y el postest. Se observa que un plan de intervención con Proyectos Pedagógicos podría contribuir al desarrollo del pensamiento numérico.

1. INTRODUCTION

The theme on the implementation of an intervention proposal using the pedagogy of projects, aimed at third grade students, for the development of numerical thinking emerged due to a concern of the researcher, given the current state of this capacity in schoolchildren COMFANORTE of the municipality of Los Patios, Norte de Santander.

THE CONCEPT OF NUMBER: DEFINITION AND PREVIOUS CONTENTS

When talking about the concept of number, it is interesting, first of all to define it. For this reason, the Dictionary of the Royal Spanish Academy is

used [1] where, in the entry to the word states that this concept comes from the Latin *numerus* and means, among different meanings, the “expression of a quantity in relation to its unit” or it can be taken as the “number of people or things of a certain species”.

Then, it can be said, taking into account the previous approach and from the empirical, that the concept of number is related to the ability of the child to classify and order objects from their environment. In daily practice, it can be observed that in order to classify and order objects, the child starts establishing small comparisons of objects, for example, arranges all toys of the same color. For this reason, it is important to keep in mind the previous experiences of the children and the contexts where the children make use of the numbers before arriving at school.

A fundamental aspect in the process of understanding the concept of number is associated with the previous contents referred to the establishment of correspondence, position value, seriation, among others. In this regard, the children elaborate conceptualizations about the writing of numbers, based on the information they extract from the spoken numbering and their knowledge of conventional writing [2]. This has implications in writing, because when the child communicates orally to express numerical aspects he does so spontaneously, but when he tries to express himself in writing as to the numbering he must take into account specific rules such as the place value of the figures, the additive character, the correspondence, among others. In such a way that, in the didactic processes students must be helped in the processes of construction of the concept of number.

Regarding the notion of number concept, in this study, it is stated that it is related to some of the aspects explained by Piaget [3], taken up by Figueras [4] who allude, that to acquire

the concept of number the Child must develop some prior skills such as the notion of general quantities as very little, many, among others; term term correspondence, classification, seriation, distinction and comparison of quantities and objects, for example, here, in this group there is more than in that; You must also acquire the principle of unity that relates to the denomination one to refer to an object.

The mentioned aspects, like previous contents, around the concept of number, constitute curricular axes of Mathematics of the Ministry of National Education of Colombia, where it is stated that in the primary education should be developed previous activities that allow the child to build the numerical thought [5]. This allows, that in the understanding of the concept of number, the children of the third grade must identify the different contents in which the numbers are present. This can lead the child to use the figures as a verbal sequence to count in a cardinal context, to measure, to describe the position of an object in a set, and progressively acquire greater skill in counting.

Hence, the importance in reviewing the stages of the acquisition of the notion of number at early ages, the procedures that the child uses to count and learning the concept of number. In principle, it is important to mention the necessary prerequisites for the acquisition of the number, which requires previous steps, they are referred to the logical reasoning and the process of classification and seriation as prenumeric aspects [6].

As for the stages, for the acquisition of the concept of number, Piaget's proposal is followed, which describes three stages in the acquisition and development of the concept of number: a first stage that goes from 4 to 5 years, characterized by the absence of correspondence term to term; the second stage referred to the age of 5 to 6 years where it appears the establishment of the

correspondence term to term but without durable equivalence and a third stage referred to the conservation of the number, which emerges at 6 years and corresponds to the stage concrete operation that concludes, around 11 years [7].

THE LEARNING OF NUMERICAL THINKING

In relation to the learning of the Numerical Thought the Ministry of National Education [5] poses the competences related to the resolution, the communication and the reasoning for the learning of the mathematics, allow the development of this subject in the students. In this regard, following this national entity, the Basic Rights of Learning, (DBA) are organized for the third grade, where the first seeks that the student interprets, formulates and solves problems in different contexts, both additive composition, transformation and comparison ; as direct and inverse multiplicatives.

This right is operationalized through the following evidences of learning: a) It builds diagrams to represent additive or multiplicative relationships observed among the quantities present in a situation, b) Solves additive problems (addition or subtraction) and multiplicatives (multiplication or division) of composition of measurement and counting, c) Proposes strategies to calculate the number of possible combinations of a set of attributes, d) Analyzes the results offered by the mathematical calculation and identifies the conditions under which that result is or is not plausible.

Another DBA is referred to the search of a student that proposes, develops and justifies strategies to make estimates and calculations with basic operations in the solution of problems. For this, the learning evidences posed by the Ministry of National Education [5] are: a) Use the properties of the operations and the Decimal Numbering System to justify in calculations actions such as: decomposition of numbers, completing up to ten

more close, duplicate, change position, multiply abbreviated multiples of 10, among others, b) Recognize the use of operations to calculate the measure (composite) of different objects in their environment, c) Argue when some attributes of objects are they can be measured by direct comparison with a unit and when they can be calculated with some operations between numbers.

The third Basic Law of Learning allows the student to establish comparisons between quantities and expressions that involve operations and additive and multiplicative relationships and their numerical representations. In this sense, the evidences of these learning are organized in: a) Performs measurements of the same object with others of different sizes and uses the fractions to establish equivalences between them, b) Uses the ratios and fractions as a way to establish comparisons between two quantities, c) proposes examples of quantities that relate to each other as they correspond to a given fraction and d) uses fractions to express the relationship of "the whole" with some of its "parts", likewise, differentiates this type of relationship from others like the relations of equivalence (equality) and order (greater than and less than).

THEORETICAL APPROACH IN THE TEACHING OF NUMERICAL THINKING

The teaching processes within the framework of Project Pedagogy are based on comprehensive constructivist planning [8] [9]. In this sense, this study, from the point of view of Vygotsky [10], poses a teacher as a mediator. Therefore, the role of the student is highly participatory, stops being mechanistic and is inserted into the world of knowledge from their own previous experiences.

In this regard, the fundamental thing is the way the teacher thinks, because it is not about saying, but about the belief that the participation of the

students is a valuable element of the formative process. Similarly, it is noted that teachers need to give space to unbalancing dialogue based on questions and questions [11]. Well, from the constructivist paradigm, students are not repositories of knowledge so they can raise their positions, ideas and thoughts on a topic. In addition, Vygotsky [10] privileges group work, which allows students the opportunity to carry out, in a more successful way, more complex skills than they can perform on their own.

Then, some premises of the constructivist approach can be synthesized [12]: a) the teacher appears as a mediator, who allows the child a greater participation, given that the knowledge is acquired through a construction process; b) for learning, social interaction is put into play from which children assimilate, organize and adapt knowledge objects; c) previous experiences and knowledge constitute essential aspects in learning, for which reason teaching must allow that the new knowledge is organized based on previously acquired knowledge.

ABOUT CLASSROOM PEDAGOGICAL PROJECTS

Pedagogy by projects, as one of the innovative educational practices that has been carried out in Colombian schools, began to be developed at the beginning of the 20th century. In this regard, different researchers and educators agree that John Dewey and William Kilpatrick are the best known representatives of the so-called method of projects, and were part of the first pedagogical movement of the twentieth century [13], [14], [15].

In the field of integral planning based on constructivist theoretical approaches, different models appear, among them the Classroom Pedagogical Projects. And these Classroom Pedagogical Projects constitute an important part of the tripolar relationship (teacher - student

- content), existing in every educational act [16]. On the other hand, the Classroom Pedagogical Projects as a model of integral planning, are based on the contributions of the constructivist approaches, which allow the construction of knowledge, take into consideration the previous knowledge of the student, integrate the teaching processes around a generator theme, the teacher as a mediator and the energizing classes with group work, videos, field trips, expert presentations, plenary sessions, among others [15], [14].

It should be noted that the Classroom Pedagogical Project is conceived as a teaching planning instrument, with a comprehensive approach that takes into account the components of the curriculum, and is based on the needs and interests of the school and the students, in order to provide them with an improved education in terms of quality and equity [17], [15]. For its part, the methodological process of the Classroom Pedagogical Projects consists of four phases: conceptual, operational, monitoring and evaluation and systematization phase [18].

2. METHOD

Research paradigm. The research was developed under the positivist paradigm. The positivist approach considers that only observable data can be object of knowledge through methods focused on statistical analysis. As for the positivist paradigm, [19] dominant in the educational field since the nineteenth century. Education adopts the principles and research methods of the physical and natural sciences, applying them to their own object of study. The positivist approach considers that only observable data can be object of knowledge through methods focused on statistical analysis. It is linked to the concept of empiricism and seeks a causal and mechanistic explanation of the phenomena of reality.

Kind of investigation. The present study is quantitative. Quantitative investigations collect and analyze quantitative data on variables. They try to determine the strength of association or correlation between variables, the generalization and objectification of the results to make inference to a population from which all sample proceeds [19]. After the study of the association or correlation, it intends, in turn, to make a causal inference that explains why things happen or not in a certain way. In the same way, quantitative research implies the achievement of eminently statistical results, where the researcher systematically observes the events underlying the effects produced by one or more variables, which, in some cases, are subject to hypotheses.

Research design. Regarding the design, the quasi-experimental method was followed with pretest and posttest of the control group, [19] taking one of the groups as the experimental group and the other as the control group. It should be noted that the groups have similar characteristics because they belong to the same institution, the same degree and to an equivalent social stratum. This design has the following structure:

It is graphed as follows:

GE1 ----- X ----- 01

GC2 ----- X ----- 02

The interrupted line indicates that the experimental (E) and control (C) groups have not been taken at random. X: Treatment. The group GE1 is given a pre-test to the treatment plan and after administering the treatment a test is applied again. Only the pretest and posttest are applied to the control group GC2.

Population. The population is constituted by 81 students conformed by two groups 3^oA of 42 and 3^oB of 39 students that, as well, conform the

sample, since the group of 3 ° To is the control and 3 ° B experimental.

Techniques and Instruments for data collection. The instrument used is an evaluation of type ICFES [20] in which it is based on the third grade DBA that evaluates three competences, reasoning and argumentation; Communication, representation and modeling; approach and problem solving, for the numerical-variational component. Which evaluates the numerical knowledge and the interpretation of the contextualized problems according to their presaberes using images or graphic representations according to the themes or competences. In addition, the observation accompanied with the daily field instrument is used as a technique. With regard to the field journal, it may contain observations, photographs and comments [19]. The use of the diary can be used to encourage description, interpretation, reflection and evaluation by both the teacher and the student.

3. RESULTS

Results of the pretest experimental group and control

By taking a general look at the students' answers, it can be inferred that the experimental group in the pretest, presents problems associated with the resolution of problems, while the negative percentages in reasoning and communication are lower than the positive ones. When analyzing the dimensions, reasoning, communication and problem solving, in the questions answered by the control group, it can be seen that the greatest difficulty is associated with questions related to problem solving, followed by reasoning, while the communication dimension is the least affected in a negative way. It can be concluded that the pretest reflects that the resolution of problems is the dimension with the greatest deficiencies in terms of numerical thinking in third grade students during the evaluation prior

to the treatment plan.

Treatment plan for the experimental group

The use of mathematics allows man to solve situations of various kinds such as: the calculation of money necessary to make a purchase, existing expenses when acquiring a product, estimation of time when traveling a certain distance, the space required when filling a container, etc. . This constant use, which is made of mathematics in all areas, led to the interest to know the level of learning reached by students in the first grade of primary education.

The student's level of learning is a factor of interest, as it is an element of the educator's analysis in relation to the meaning and usefulness of the content outside the institutional environment. Similarly, the teaching practice used, is another reason for inquiry, to examine the teaching process that takes place from the Pedagogy of Projects for the learning of the numerical thought in students of the third degree of the Educational Institution COMFANORTE of the municipality of Playgrounds. For this, six pedagogical projects are designed.

In this context, the new plans and programs, with the aim of raising the quality of education, have undergone substantial changes. These changes have been from teaching the theory through memorization to a constructive practice, giving more meaning to the learning used in everyday life. However, it continues to proceed routinely using memorizations and exposures.

In such a way, that this intervention plan has its justification in the legal bases that support the teaching of mathematics in Colombia. The main legal foundations that govern Colombian education are framed in the Political Constitution of Colombia (1991) and the General Law of Education (1994) that establishes the norms

related to the provision of the educational service of Primary Education.

Also, as already mentioned, the research was carried out in the Educational Institution COMFANORTE, which is a private institution, which is part of the Family Compensation Fund of Norte de Santander, COMFANORTE, consequently, part of the Family Subsidy System. Through the educational institution, the Family Compensation Fund of Norte de Santander, COMFANORTE, develops the Social Service of Education. It is characterized for being an institution that educates integrally under principles of efficiency, solidarity and social equity, through the granting of the subsidy and the provision of quality service.

The Educational Institution COMFANORTE applies the constructivist model with a dialogical approach for the development of each and every one of the curricular and complementary activities proposed and developed by the institution. Its mission is the use of effective and innovative educational models, we are responsible to fulfill the trust placed in us to fully educate the individual towards their development as a being of value to society. Vision: Our purpose 2016-2018. "Construction of an intelligent Educational Institution". Education with excellence.

The intervention plan described here has four phases, already explained in the theoretical framework. Conceptual Phase, which corresponded with the moment of reflection with the children to talk about the topics to be developed and their purpose. The operational phase corresponds to the design of each project and is organized into theme, execution time, objective and didactic situations, which include media activities and evaluation. The monitoring and evaluation phase, in this investigation will be linked to the Systematization Phase. Below is a summary of the design of each project.

Pedagogical project 1: adding, adding adding up. It served as support for the development of the topic on addition. It had a duration of 2 hours distributed over four days and the objective allowed to develop real sums and problems through didactic instruments that contribute to strengthen mathematical logical reasoning. Among some activities, a practical example is mentioned with material and activities of sums using logical blocks and in pairs with logical rings.

Pedagogical project 2: let's find the difference. Topic, Subtraction, duration 2 hours. The objective was to use the abacus as an instrument for the development of subtraction and reasoning problems in an environment close to everyday life. Among some activities developed are: practical example with the material step by step to use the abacus. Subtraction activities using the abacus.

Pedagogical project 3: learning to multiply playing. The subject is referred to multiplication with 2 hours and had as activities; perform multiplications using the process of addition, through the multifichas as support for the solution of problems. Practical example with the material multiplication activities using the subtractions with the multifichas

Pedagogical project 4: the world of divisions. Two (2) hours. The objective was to solve exercises and application problems to real situations using the division. Some activities are: practical example with the division material with a number and its test division activities with a number using the grouping with the multifichas.

Pedagogical project 5: I have fun with mathematical problems. The objective was to solve problems with the basic operations of mathematics with the help of tics for more meaningful learning. Time 2 hours. Some activities are; visualization of didactic videos with

problems for the solution of the four operations and fractional numbers

Pedagogical project 6: fractionating amounts. This project gave way to the topic of representation of fractions with 2 hours duration. The objective was to solve basic operations of mathematics with the help of tics for more meaningful learning. Among some activities are mentioned; practical example with the material in which the definition of the parts of a fraction is retaken, activities of graphic representation of fractionaries using the fractional cakes.

RESULTS OF THE POSTTEST CONTROL AND EXPERIMENTAL GROUP

When analyzing the results obtained during the posttest, it can be concluded that the experimental group increased the scores in the three evaluated dimensions. The problem solving that was constituted in the dimension with the lowest scores in the pretest, significantly increased the scores in the posttest, after the students participated in a treatment plan. Regarding the control group, the problem resolution dimension remains the most problematic, however in none of the three dimensions (reasoning, communication and resolution) was it observed an increase in the scores during the posttest of this group.

4. DISCUSSION

This study, without pretending to be exhaustive in each of the points analyzed, has tried to synthesize the basic aspects that involved the design and implementation of an intervention plan.

Prior to the implementation, a pretest was developed that sought the development of the first objective. Regarding the design of the proposal corresponding to the second objective, it can be said that it was based on the Brosseau Theory of Didactic Situations [18] and was

organized into projects for each of the selected topics.

The posttest allowed to observe some improvement in the execution of topics associated with the number in the students of the experimental group. In this sense, it is stated that in order to acquire the concept of number the child must develop some previous skills such as the notion of general quantities as very little, many, among others; term term correspondence, classification, seriation, distinction and comparison of quantities and objects, for example, here, in this group there is more than in that; he must also acquire the principle of unity that is related to the denomination one to refer to an object [10].

5. CONCLUSIONS

The teaching of numerical thinking in third grade students to be effective needs to know the characteristics of the context, understood in a broad way. Only in this way can he be able to adjust the intervention with Pedagogical Projects to the real needs of the student and evaluate the effectiveness of the strategies. In summary, it can be said that one of the starting points to be able to adjust the educational intervention properly is to make an initial diagnosis of the control and experimental groups, as happened in this investigation.

Regarding the viability of the developed strategies understood as the ease of implementation in the classroom. It can be said that the treatment plan is viable insofar as they are developed without significant changes of the proposed design and with the usual classroom situation. So, it can be said that, in general, the treatment plan is viable although some changes of improvement should be included; specific:

a) The strategies were put in place without significant changes between the proposal and the

implementation in the classroom: the materials were used as designed, the only thing that was modified was the teaching role, more dedicated to the planning and orientation of learning, as it was formed in the previous course.

b) Needs for increasing material resources have been raised, but they were covered by the researcher.

c) No adjustment was made in the development of the intervention plan. Six intervention projects had been proposed and in the foreseen time they were executed.

The posttest shows that there was a significant increase in the results of the experimental group..

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