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A TEACHING SEQUENCE FOR THE CONCEPTUAL STUDY OF FRACTIONS USING MANIPULABLE MATERIALS

UMA SEQUÊNCIA DIDÁTICA PARA O ESTUDO CONCEITUAL DE FRAÇÕES COM USO DE MATERIAIS MANIPULÁVEIS

UNA SECUENCIA DE ENSEÑANZA PARA EL ESTUDIO CONCEPTUAL DE LAS FRACCIONES UTILIZANDO MATERIALES MANIPULABLES

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ABSTRACT
In this qualitative research, the use of manipulatives as a tool for introducing the concept of fractions was investigated. The activities were carried out with 91 elementary school students from a federal school in the municipality of Santa Maria, RS, Brazil. Based on the activities developed, the aim was to analyze whether the use of manipulatives contributed to student learning by fostering skills related to the formation of mathematical concepts involving rational numbers, understanding geometric representations, and connecting them to everyday situations. The results were analyzed through observations following the stages of Didactic Engineering. In the activity described here, it was observed that most students achieved significant progress in the assessments and subsequent tasks, and particularly enjoyed carrying out the activities, manipulating the materials, and interacting with their peers.

Keywords: Fractions. Didactic Engineering. Manipulatives.

RESUMO
Nesta pesquisa qualitativa, investigou-se o uso de materiais manipuláveis como ferramenta para a introdução do conceito de fração. As atividades foram desenvolvidas com 91 alunos do Ensino Fundamental de uma Escola da rede federal no município de Santa Maria, RS. A partir das atividades desenvolvidas, pretendeu-se analisar se os materiais manipuláveis contribuíram para o aprendizado dos alunos despertando habilidades de formar conceitos matemáticos sobre os racionais, compreender a representação geométrica e relacionar a situações vinculadas ao dia a dia. Os resultados obtidos foram analisados a partir das observações seguindo as etapas da Engenharia didática. Na atividade aqui descrita, notou-se que a maior parte dos alunos teve um aproveitamento significativo nas avaliações realizadas e nas atividades posteriores e, em especial, apreciaram a realização das atividades, a manipulação dos materiais e a possibilidade de interação com os colegas.

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Palavras-chave: Frações. Engenharia Didática. Materiais Manipuláveis.

RESUMEN
Esta investigación cualitativa investigó el uso de materiales manipulativos como herramienta para introducir el concepto de fracciones. Las actividades se desarrollaron con 91 estudiantes de primaria de una escuela federal del municipio de Santa Maria, RS. Con base en las actividades, el objetivo fue analizar si los materiales manipulativos contribuían al aprendizaje de los estudiantes, fomentando habilidades para la formación de conceptos matemáticos sobre números racionales, la comprensión de la representación geométrica y su relación con situaciones cotidianas. Los resultados obtenidos se analizaron con base en observaciones siguiendo los pasos de la Ingeniería Didáctica. En la actividad aquí descrita, se observó que la mayoría de los estudiantes tuvieron un desempeño significativo en las evaluaciones y actividades posteriores. Disfrutaron especialmente de las actividades, la manipulación de los materiales y la oportunidad de interactuar con sus compañeros.

Palabras clave: Fracciones. Ingeniería Didáctica. Materiales Manipulativos.

1 INTRODUCTION

The great challenge of the professional who teaches Mathematics today is to propose a work that provides the student with the development of the ability to learn and understand the world in which he lives, acting in a critical and participatory way. This concern is evident in the different proposals presented in the National Curriculum Parameters (PCN).

According to the PCN (BRASIL, 1998, p. 21),

> [...] Brazilian society demands quality education that guarantees the essential learning for the formation of autonomous, critical and participatory citizens, capable of acting with competence, dignity and responsibility in the society in which they live and in which their individual, social, political and economic needs expect to be met. (BRASIL, 1998, p. 21),

However, for this process to be full and satisfactory, it is necessary to take a close look at the student's learning and a well-defined objective for teaching, directed to the student who wants to graduate. From the reflection of their pedagogical practice and the results that students are presenting in school learning, the educator will realize the need to change their methodology in the classroom.

For this, it is necessary to search for new methodologies and didactic resources in order to make the teaching of Mathematics contextualized, that is, to work with practical situations related to problems of the student's daily life. However, before applying the didactic proposal in the classroom, it is necessary to reflect on what kind of education one wants, what man, what society, what school one wants to build.

The use of manipulable materials can help to reinforce the teaching proposal we choose, since it allows us to overcome the ready-made and finished teaching, exposed through rules and "tricks", through activities that make the student discover the concepts in a pleasant environment and in interaction with colleagues. But the educator needs to check what the students know about content already taught, so that they can reflect on the level of difficulty of the topics to be taught and develop teaching strategies for the monitoring and individual and collective evolution of the students.

The motivation for this project came through classroom practices with 6th grade students in the study of operations with fractions. As the students were faced with new problem-situations involving these operations, the difficulty arose in identifying the appropriate operation for each situation.

According to the Lessons of Rio Grande (RIO GRANDE DO SUL, 2009, p.56-57), when suggesting the proposal of an ordered sequence of learning situations for the 5th and 6th grades (6th and 7th grades),

> The proposed learning situations allow the student, when constructing mathematical concepts, to discuss, confront, select and expose orally and in writing relevant ideas, make comparisons and inferences, through reading, seek information and record them, as well as their hypotheses and conclusions, in the conception that learning takes place and is consolidated by problem solving. [...] Fractional numbers, decimal numbers and simple percentage calculations are presented from the Monetary System, starting from everyday situations, exploring the students' previous knowledge. (RIO GRANDE DO SUL, 2009, p.56-57)

From this reflection, the importance of previous knowledge - contents already studied - which serve as support for new knowledge - was considered. In view of this, it is believed that the teaching of Mathematics should be worked not only with practical situations of daily life, but also through educational practices, with planning, methodology and appropriate didactic resources, which will develop in the student logical reasoning, coherence and understanding of basic operations.

According to Gigante, Silva and Santos (RIO GRANDE DO SUL, 2009, p. 38),

> To develop logical-mathematical thinking is to compare, classify, order, correspond, it is to establish all kinds of relationships between objects, actions and facts, between sets, between elements of sets. Thus, in the essence of Mathematics itself is the concept of relationship that structures it and that is expressed in speech, writing and in different representations. Arithmetic thinking is initially developed from the need for counting, ordering, and the construction of the Natural Number and numbering systems, especially the decimal, which expands in the understanding of the meaning of operations, which, in turn, are defined from the resolution of problems. From the need to measure, the numerical field is expanded with fractional numbers in their different forms (fractional and decimal), which express measures, ratios, relations of proportionality. (RIO GRANDE DO SUL, 2009, p. 38),

2 DEVELOPMENT

2.1 THE USE OF MANIPULABLE MATERIALS IN THE TEACHING OF MATHEMATICS

Clements and McMillen (1996) question the expressions "concrete" and "manipulable", when referring to materials that help learning. According to them, "concrete" cannot simply be equated with "manipulable". It cannot be certain that the student sees the same thing as his teacher when looking at a "concrete" material, such as the golden material, for example, because the teacher already knows what mathematical concepts are associated with the use of this resource.

The authors also comment that physical actions on certain manipulable materials may suggest mental actions different from those that the teacher would like his students to learn, as they do not carry the meaning of the mathematical idea.

As there are differences between the expressions "manipulable material" and "concrete material", the meaning of "manipulate" was searched in the Houaiss dictionary (HOUAISS; VILLAR, 2009, p. 485), who explains that the act of manipulating refers to "preparing, activating or controlling with the hands". Since the materials we are going to work with allow students to perform these actions with their hands, we chose to use the expression "manipulable material".

Batista and Spinillo (2008) comment that the idea behind the material is that it makes its manipulation a key factor in the process of use. The authors also question the separation between the character of manipulation and that of representation, associated with the concrete material. According to them, objects such as vases, flowers and tokens, although manipulable and concrete, are of a different nature:

> The hypothesis is that concrete material with a clear and defined relationship with the referents of the quantities present in the problem statement (carts and boxes, vases and flowers) would help in the resolution more than undefined concrete material, whose relationship with the referents is not evident (plastic cards). The idea behind this hypothesis is that it is not only the manipulative character of the objects that would facilitate the resolution of problems, but the fact that the concrete material presents a defined relationship with the referents of the quantities present in the problem statement. (BATISTA; SPINILLO, 2008, p. 15).

Nacarato (2004-2005, p. 1), when reviewing the origin of the use of manipulable materials in teaching in the nineteenth century and its appearance in Brazil, comments that "the incentive to use manipulable materials is present in most current textbooks and, perhaps, as a result, the teacher has been incorporating a discourse about its importance".

The author emphasizes the fact that the discussion about the importance of the use of manipulable materials has been overtaken in recent years by the debate about the use of problem solving, mathematical modeling, and the use of games, among other topics. However, the teacher, often without resources in his schools, deals with textbooks that present many illustrations of materials that this teacher does not know and does not know how to use. Thus, Nacarato (2004-2005) points out some mistakes he has observed in the use of manipulables, such as: lack of interaction of the student with the material; waste of time with the request that the student draw pieces of the material that is presented to him.

Nacarato (2004-2005, p. 5) concluded that "no didactic material – manipulable or of any other nature – constitutes salvation for the improvement of Mathematics teaching. Its effectiveness or not will depend on how it is used."

The fractions begin to be taught to students in the 4th year of elementary school. According to the analysis in books of the series, fractional numbers are approached through geometric representation, being presented as part of a whole. If we consider that the fraction is a number, regardless of being a part of the whole, the use of concrete material as a didactic resource may not guarantee the understanding and meaning of what a fraction is.

Also considering the individual differences, the age group and study habits of the students with whom this research is developed, the concern arose about how to motivate them and lead them to learn in a pleasant and satisfactory way. To meet the challenge of teaching Mathematics so that the student actively participates in the process of knowledge construction and understands the meaning of what he is learning, it is necessary to reflect on the difficulties encountered. It is important that the student understands the meaning of the techniques and algorithms, so that he can develop skills for the interpretation of problems, for example.

It is important to be very clear about the reasons that lead us to use a certain material. According to Lorenzato (2006, p. 18),

> The teacher should ask what he will use the material for: [...] to present the subject, to motivate the students, to help the memorization of results, to facilitate the rediscovery by the students? It is the answers to these questions that will facilitate the choice of the most convenient MD [teaching material] for the class. (Lorenzato, 2006, p. 18),

With this research, it was thought to lead students to a learning of fractions through curiosity, challenges and the manipulation of differentiated didactic resources, providing interaction, reflection, the development of logical reasoning and the internalization of knowledge, instead of simple memorization. Thus, in order to motivate the interest and the necessary conditions for the formation of mathematical concepts over rational ones, teaching activities can be developed from playfulness, more specifically through manipulable materials. With the use of this type of materials, it is expected that the student can investigate, explore alone and with his colleagues, seeking to formalize the abstract from manipulation.

Thus, you can work with cutouts, puzzles, games and other materials that can be touched and moved from one side to the other, which gives students concrete ways to solve problems about operations with fractions.

3 PREVIOUS ANALYSES

In this item, the dimensions indicated by Artigue (1996) for the performance of previous analyses are addressed. Firstly, regarding the knowledge at stake, the conceptions of fraction and aspects of its teaching are addressed. Secondly, regarding the characteristics of the education system, a brief analysis of the presentation of the content of fractions in textbooks and a characterization of the school in which the project will be developed is made. The cognitive dimension, associated with the participating students, will be addressed through a test applied to the students, already in the phase of the activities carried out, substantiating a resumption of the previous analyses.

From a historical review of the emergence of fractions, it is noted that, with human evolution, the first considerations resulted from the daily activities of ancient peoples.

The fractional number appeared around 3000 B.C. C. in Ancient Egypt, due to the need to carry out land measurements due to the floods that occurred annually in the period from June to September on the banks of the Nile River. The demarcation of land lots was carried out by "rope stretchers" (or surveyors), and was carried out by observing how many times a unit of measurement was contained in the land lot. Because the measure does not always result in an integer, there was a need for a new concept of number, called fractional number. (CAJORI, 2007).

With the emergence of fractions, there was a need to represent them. Initially, the Egyptians used unit fractions, as they interpreted the fraction only as a part of the unit. The unit fractions were represented by an elongated oval sign over the denominator.

Cajori (2007, p. 37), when describing the way the Egyptians worked with fractions, states:

> The Ahmes papyrus contains important information [...] Their methods of operation were, of course, quite different from ours. Fractions were a matter of great difficulty for the ancients. Simultaneous changes in the numerator and denominator were avoided. By manipulating fractions, the Babylonians kept the denominator (60) constant. The Romans also did the same, but in their case, with the value 12. The Egyptians and Greeks, on the other hand, kept the numerator constant, and worked with variable denominators. Ahmes used the term "fraction" in a narrow sense, as he applied it only

to unit fractions, that is, fractions with a constant denominator equal to one. The custom was to write the denominator with a dot on top. Fractions that could not be expressed with the numerator one were written unfolded in the sum of fractions of numerator one. So they wrote $\frac{1}{3}\frac{1}{15}$ instead of $\frac{2}{5}$. Although Ahmes knew it $\frac{2}{3}$ to be equal to $\frac{1}{2}\frac{1}{6}$, he curiously let $\frac{2}{3}$ it appear between the unit fractions and even adopted for this particular fraction a special symbol. (CAJORI, 2007, p. 37)

3.1 THE DIFFERENT MEANINGS OF A FRACTIONAL NUMBER

Fractions are present in various moments of our daily lives and, in general, appear in very simple situations, such as "half a cup of coffee" and "half a kilo of rice", for example. If the teacher were to adapt the fractions strictly to simple situations in the daily life of the students, he would have very little to work with. Even a fractional number can have different meanings, such as the fraction $\frac{1}{2}$, in turn, can be interpreted as half of a ticket to the cinema and also as a percentage (50% of the ticket value); it can be represented as 0.50, when we can understand it as a monetary value; also as a ratio of 1 to 2, That is, if we relate this situation to questions in an evaluation, we can say that, for every 2 questions solved, one is wrong.

The National Curriculum Parameters (BRASIL, 2000) point out obstacles faced by students in learning rational numbers. Among them, the following are mentioned: the fact that each rational can be represented by different (and infinite) writings; the comparison between rationals, because, since students are used to working with naturals, it is difficult to accept, for example, that $1/3<1/2$ or that $2.4 > 2.1234$; the difficulty of understanding that it makes no sense to speak of the successor of a rational one, since between two rational ones there is always another rational. The same document also points out that, being accustomed to using, in everyday language, only expressions such as half, third or fourth, students have difficulties in understanding the different representations of rational numbers.

Several authors have cited the different meanings of rational numbers. In the PCN (BRASIL, 2000), the following meanings are mentioned: part-whole relationship, quotient, reason or operator. Although the part-whole meaning is the most used in Elementary School, the document also points out the meaning of quotient, commenting that this meaning differs from the previous one "because dividing a chocolate into 3 parts and eating 2 of these parts is a different situation from that in which it is necessary to divide 2 chocolates for 3 people. However, in both cases, the result is represented by the same notation: 2/3." (p.103).

The PCN also point to a third situation, different from the previous two: "the one in which the fraction is used as a kind of comparative index between two quantities and a quantity, that is, when it is interpreted as a ratio" (BRASIL, 2000, p. 103). The meaning of operator appears when the fraction "plays a role of transformation, something that acts on a situation and modifies it". (Ibid., p. 104).

Allevato and Onuchic (2007, p. 2) when dealing in their text with the "different personalities" of rational numbers, state:

> The different personalities that rational numbers can assume constitute distinct semantic fields. To understand the meaning of "rational numbers" one must consider the mathematical theory to which they are subjected, the class of real-world situations to which they apply, and the relationships between the theory and these situations. (ALLEVATO AND ONUCHIC, 2007, p. 2)

According to these authors, the different "personalities" are:

a) Rational point: this meaning appears when we take the number line and, by associating each real number to a point on the line, each rational is associated with a certain point and vice versa. For example, if we take the rational $\frac{4}{7}$, it corresponds to a single point on the line and if the student divides 4 by 7 to get an approximate decimal (0.57) and knows where to indicate the point on the line, that point does not correspond to the rational $\frac{4}{7}$, because 0.57, which can be written as $\frac{57}{100}$ is not a fraction equivalent to $\frac{4}{7}$.

b) Quotient: the rational has the meaning of quotient when it results from the division of a certain number of objects into equal parts among a certain number of elements. For example, dividing 4 chocolate bars among 7 children $\frac{4}{7}$ is the amount of chocolate that each one will receive.

c) Fraction or part-whole relationship: in this case, the denominator indicates how many parts the whole was divided into and the numerator indicates how many parts were taken from that whole.

d) Operator: a rational number is understood as an operator if it represents an action that is made on a number. For example, if we say that 14 students went for a walk and of these, $\frac{4}{7}$ they have already returned to the classroom, we have to multiply $\frac{4}{7}$ by 14 to know how many students are in class

e) Reason: the meaning "reason" indicates a comparison between quantities. A classic problem, presented by Allevato and Onuchic (2007) and also by Merlini (2005) is to take two jars that contain different mixtures of two products (e.g., water and orange concentrate) and ask students to indicate the ratio between the two products in the resulting mixture.

Allevato and Onuchic (2007, p. 8) consider that

> [...] The concept of ratio is relevant because it underlies the concept of proportionality [...] and from proportionality derive other important concepts and contents: rules of three, division into proportional parts, mixtures, percentage, discounts, rates, scale, population estimates, direct variation, inverse variation, trigonometric ratios, similarity of triangles and probabilities. (ALLEVATO AND ONUCHIC, 2007, p. 8)

Behr et al. (1983) also present the different meanings of rationals, in a text that has been cited by many authors who investigate the teaching and learning of fractions. For them, there are four meanings – measure (or part-whole), quotient, ratio, and operator – each of which provides a different quantitative and relational experience. Part-whole interpretation "depends directly on the ability to break up both a continuous quantity and a set of discrete objects into subparts or sets of the same size." (p. 93).

Also according to the same authors, the symbol a/b is often used to indicate a division of a by b. In this case, the "quotient" meaning of the rational number is present. The meaning "reason" is, according to them, more correctly considered as an index of comparison than a number; Its importance is linked to the fact that a ratio, which is an expression that equals two ratios, is used in many applied problems.

Finally, in the interpretation of Behr et al (1983), the rational number as an operator has an algebraic interpretation; p/q can be thought of as "a function that transforms one set into another with p/q times the number of elements". (p. 95).

After analyzing the various ways in which fractions can be represented, it is important that the educator can understand what skills and competencies are expected of the student. the Curricular References for Rio Grande do Sul point out:

- Relate parts of a symmetrical figure to the idea of fraction.
- Identify more than one axis of symmetry in figures.

- Identify pattern as part of a repeating figure.
- Understand the emergence of fractions within a historical context.
- Recognize the fraction as a consequence of the act of measuring.
- Understand the idea of a fraction within a historical context.
- Identify, represent and translate orally or in writing a fraction.
- Correctly use the expressions: numerator and denominator to name the terms of a fraction, expanding the mathematical vocabulary.
- Understand what the numerator and denominator of a fraction represent.
- Recognize a fraction as part of congruent parts.
- Recognize that, in order to find a fraction of a collection, it is necessary that its total of pieces is divisible by the number of parts that we want to divide it. (RIO GRANDE DO SUL, 2009, p.82-83)

The current challenge of the educator is precisely to find ways that lead students to appropriate the knowledge about fractions, acquiring the skills and competencies described above.

4 RESEARCH METHODOLOGY

The present project uses Didactic Engineering as a research methodology, to analyze the application of manipulable materials for the teaching of basic operations with fractions, with students of the 6th year of Elementary School of a federal public school. It is, therefore, a research with a qualitative approach. With this research, it is intended to obtain answers to the following questions:

- How has the content of operations with fractions been taught to students in the 6th grade of Elementary School?
- How can manipulable materials be used to construct concepts about fractions?

The general objective is, therefore, to investigate the use of manipulable materials for the teaching of fractions, following the steps of Didactic Engineering.

Among the specific objectives, we have:

a) research the existence of manipulable materials available on the Internet or other means of information, for the teaching of operations with fractions;
b) analyze the textbooks, to verify how the content of operations with fractions is being presented;

c) to develop a didactic sequence for working with operations with fractions with the support of manipulable materials;
d) analyze the students' learning after the application of the didactic sequence.

The data collection instruments for the investigation are linked to observation, interaction among students, teacher's questions during the activities developed by the participants and lists of exercises answered by them.

The participants of the research were 91 students of the 6th grade of Elementary School of the federal public school in the municipality of Santa Maria – RS, already mentioned.

5 RESULTS

Next, the data collected during the application of one of the activities developed with 91 students of the 6th year of Elementary School are presented and analyzed.

During the applications of the activities on fractions, the students' arguments were fundamental aspects for future analysis. The students' dialogues with the teacher and the interaction between the students produced, in an explanatory character, the form of reasoning and description of the path that led them to a certain conclusion. The statements raised during the debates, whether they were right or wrong, caused acceptance or rejection by the students. In this chapter, it will be described, step by step, how one of the activities was carried out.

5.1 DIDACTIC SEQUENCE I: CONCEPT OF FRACTION THROUGH THE PUZZLE

The first research instrument was developed during two classes of 45 minutes each. Initially, each student was asked for a private photograph, which was later given to the teacher, for the elaboration of a puzzle. After the preparation of the material carried out by the teacher, a script of the first activity applied was elaborated, based on questioning and manipulation of the material.

5.1.1 First: preparation of the didactic material

The process of constructing the puzzle, using the student's photograph as an image, was previously carried out by the teacher with the aim of making full use of the class time to explore the concept of fraction. Therefore, among the different meanings of rationals, according to Allevato and Onuchic (2007), this activity addresses the part-whole relationship.

Figure 1

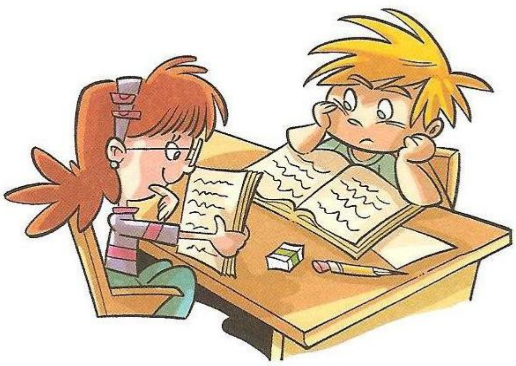
Preparation of the puzzle

5.1.2 Second moment: activity script

The student received his photo in the format of a puzzle, disassembled and missing pieces. The goal is to introduce the notion of fraction as part of an integer.

Figure 2

Illustration of the puzzle with 30 pieces[7]



[7] In this figure, we present an image to avoid identifying any student through their photograph.

Next, it was requested:

- Assemble the puzzle to get your photo again;
- How many pieces does the puzzle have?
- Is the puzzle complete? Check.
- Are there missing pieces? If the answer is "yes", how many pieces are missing?
- Indicate the number that corresponds to the total number of pieces in the puzzle;
- Indicate the number that corresponds to the missing pieces to complete the puzzle;
- What is the fraction that indicates the number of missing pieces in relation to the whole?
- Represent the fraction that indicates the number of pieces that are not missing, in relation to the whole.

5.1.3 Third moment: application and analysis of the results

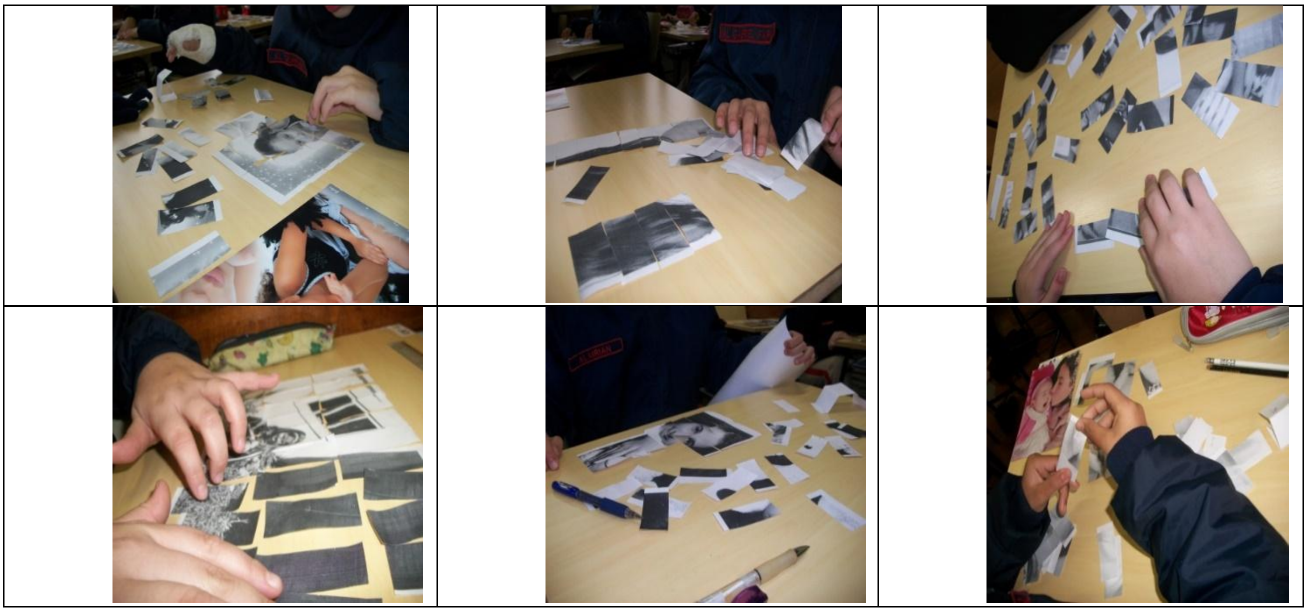
Initially, the puzzles were distributed individually, totaling 91 games containing 30 pieces each. The students, individually, in front of the puzzles scattered under the table, began the assembly. Two questions then arose: "Teacher: after I assemble what are we going to do?", "my puzzle is missing pieces" or "mine is not complete!".

The script mentioned in item 5.1.2 was carried out orally by the teacher and answered by the students. During the application of this first activity, it was noted the students' motivation to assemble the puzzle and the diversity of reactions during its manipulation contributed significantly to its analysis. For example, while only waiting for answers to the questions, some students formulated new questions such as: "if there were no missing pieces, how would I represent a fraction?", "why does the fraction 30/30 represent an integer?", "If the puzzle were complete, could I represent it as a fraction?", "why can't I represent the missing pieces like this: 30/ 3" . In addition, a knowledge that was built during the understanding of the concept of fraction was the way we represent the fraction.

From the analysis carried out, it becomes evident the important role played by oral questioning and manipulation of the puzzle, concomitantly. Associating the puzzle with the concept of fraction enabled the student to understand the meaning of the terms of the fraction, its representation and exploration of the concept of division directly linked to fractions. According to Nacarato (2004-2005), the puzzle itself does not provoke understanding, but its use, in this context of teaching fractions, allowed students to better understand the subject.

Figure 3

Application of the activity



6 FINAL CONSIDERATIONS

The activity presented in this text sought, from the use of manipulable materials, to contribute to the teaching of fractions, especially the part-whole meaning. The reflections on the activity made it possible to perceive that using differentiated materials associated with the student's daily life enables the opening of new ways of introducing mathematical content, allowing those involved to get in touch with their own social experience, providing a pleasant and meaningful learning environment.

We consider that the activity applied to these 6th grade students came in line with what is suggested by the Lessons of Rio Grande (RIO GRANDE DO SUL, 2009), as the students' previous knowledge was explored, namely, their ability to assemble puzzles and the knowledge of their own photography.

Also, the questions asked by the teacher and the students, during the construction of the puzzle, allowed them to confront the knowledge that was being built.

REFERENCES

Allevato, N. S. G., & Onuchic, L. de la R. (2007). O ensino de números racionais e proporcionalidade através da resolução de problemas. In Actas de la 12ª Conferencia Interamericana de Educación Matemática [CD-ROM]. Mexico: Edebé Eduziones Internacionales.

Artigue, M. (1996). Ingénierie didactique. In J. Brun (Ed.), Didactique des mathématiques (pp. 244–274). Lausanne, Switzerland: Delachaux et Niestlé.

Batista, A. M. da S., & Spinillo, A. G. (2008). Nem todo material concreto é igual: A importância dos referentes na resolução de problemas. Estudos de Psicologia, 13(1), 13–21. https://doi.org/10.1590/S1413-294X2008000100002

Behr, M., Lesh, R., Post, T., & Silver, E. (1983). Rational number concepts. In R. Lesh & M. Landau (Eds.), Acquisition of mathematics concepts and processes (pp. 91–125). New York, NY: Academic Press. Retrieved July 24, 2011, from http://www.cehd.umn.edu/rationalnumberproject/83_1.html

Brasil. Ministério da Educação. Secretaria de Educação Fundamental. (1998). Parâmetros Curriculares Nacionais: Terceiro e quarto ciclos do Ensino Fundamental: Introdução aos Parâmetros Curriculares Nacionais. Brasília, Brazil: Ministério da Educação. Retrieved May 20, 2011, from http://portal.mec.gov.br/seb/arquivos/pdf/introducao.pdf

Brasil. Ministério da Educação. Secretaria de Educação Fundamental. (2000). Parâmetros Curriculares Nacionais: Matemática (2nd ed.). Rio de Janeiro, Brazil: DP&A.

Cajori, F. (2007). Uma história da matemática. Rio de Janeiro, Brazil: Ciência Moderna.

Clements, D. H., & McMillen, S. (1996). Rethinking ‘concrete’ manipulatives. Teaching Children Mathematics, 2(5), 270–279. Retrieved July 25, 2011, from http://investigations.terc.edu/library/bookpapers/rethinking_concrete.cfm

Houaiss, A., & Villar, M. de S. (2009). Minidicionário Houaiss da Língua Portuguesa. Rio de Janeiro, Brazil: Objetiva.

Lorenzato, S. A. (2006). A laboratório de ensino de matemática e materiais didáticos manipuláveis. In S. A. Lorenzato (Ed.), O laboratório de ensino de matemática na formação de professores (pp. 77–92). Campinas, Brazil: Autores Associados.

Nacarato, A. (2004–2005). Eu trabalho primeiro no concreto. Revista de Educação Matemática, 9(9–10), 1–6.

Rio Grande do Sul. Secretaria da Educação. (2009). Lições do Rio Grande: Matemática e suas tecnologias. Referencial curricular. Porto Alegre, Brazil: Secretaria da Educação.