MATHEMATICS WITH SENSE: A DIDACTIC APPROACH FOR TEACHING STATISTICS AND PROBAILITY FROM EARLY AGES ON

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Between 2000 and 2005 a didactic research project has taken place in kindergarten with five-year old. The starting point of such research consisted of finding out if children were able to start learning some statistics and probability notions, thus determining which notions were feasible to be learnt The research was connected to the feasibility of implementing the "CONTRATO DIDÁCTICO APROXIMATIVO" (approximate didactical contract) proposed by Brousseau-Chevallard and the organization of classes into phases, in the framework of a Dialectics Tool-Object defined by Regine Douady. During this project a chain of didactic macrosituations was designed, implemented, analysed and restructured.

INTRODUCTION

Nowadays, a from social-pedagogical perspective, Kindergarten Education acquires a new meaning: a space of socialization of knowledge, an institutionalised educative space responsible of guaranteeing children's appropriation of relevant knowledge to act in society. It is undeniable that the society in which children live and must be prepared for, is open to a highly symbolic unstable global world, overloaded with information where the educational requirements are very different from the ones stated ten or twenty years ago. If school neglects this reality and keeps static or moving slowly compared to the outside rhythm, a divorce between school and society will be imminent. To avoid this, teachers should be aware of changes in the world and implications that this evolution has in the future insertion of students.

In order to have students being intelligent consumers, capable of making critical and well-informed decisions it is essential to have some knowledge of statistics and probability. School must raise students´ awareness of statistics and probability concepts and processes. Santaló, L. (1994) referring once more to Fischbein´s research points out: "… the genesis of the idea of probability in the formation of thinking has been studied and there is important research about it made by Piaget and Inhelder (1951) and followed by Fischbein (1975) among others. It has been concluded that probability is not as intuitive as determinism which has centuries is his favour, but it can be made intuitive from early ages with a suitable introduction and practice…" On the other hand, C. Batanero, following Fischbein, says: "…Other aspect that has already been pointed out by Fischbein (1975) is the exclusively determinist character that the Mathematics Curriculum has had until a few years ago and the necessity of showing the students a more balanced imagine of reality. In the contemporary world, scientific education can not be reduced to a univocal interpretation of events. An efficient scientific culture demands education in statistical and probability thinking..."

The emerging obligation of instructing children from early ages in probability and statistical thinking is unavoidable since the more you delay acquainting students with statistics and probability, the more difficult error prone comprehension and will be later on. In this respect Baroody, A (1994), says: "…The first approaches that a student makes towards the Mathematics learning, will be of high importance for future learning, being this one acquired at early age the support and basis of formal Mathematics that will be built in the systematic education." (Translated from Spanish by G. S. Barberán.)

DESCRIPTION OF AIMS ACHIEVED

Most five-years old children in classes where the research has taken place, recognize in a random experiment the sample space and are able to appreciate if an event is impossible, sure or probable. Although the degrees of probability are not noticeable for all of them, when the teacher makes them think about this respect, about the relationship between the sample space and kind events, they are able to visualize this relationship and then transfer it to other similar situations. In

this way, and according to the ideas of Fischbein, we propose teaching the probability intuition in a systematic way.

Regarding the initiation of statistics, we have become aware of children's potential for processing statistical information and consistent decision making, generating critical-reflexive thinking. Situations in which statistics notions were introduced pretended to be real situations, situations normally experienced by adults.

The methodological strategies used by teachers have made it possible to initiate children in the development of competences related to problem solving, investigation, cooperative work, confronting ideas, argumentation connected with communication, validation and process of meta-resolution (action-thinking); skills which are essential to achieve in higher level of teaching but they must start in early teaching in order to reach their optimisation.

During the course of this project, the idea of "DIDACTIC MACROSITUATION" comes up. It is defined as follows: A group of didactic situations, interrelated and integrated in a meaningful context which gives sense to the knowledge to be acquired, getting the child involved in learning from the necessity of solving a situation. To design these macrosituations, firstly, an appropriate context must be found, that is to say, once it is fitted, an analysis of possible connections of sense with teaching points to approach is done. Nothing is forced; the mathematical contents must emerge "naturally" and in this way they must be introduced. Everything must be interrelated and integrated, we mean, all the sequences of activities must connected with an specific aim which will not be noticed by children as imposed but as emerging necessity that is being presented, a problem that is being considered (a-didactic situations). Once the context and the network of situations related to the context have been set up, the mathematical notions will arise as tools for problem solving, that is, functionally, (dialectical instrument-object) the network of content related sequences of activities is set. It is important to underline the necessity of teacher's intervention, the teacher must be mediator between knowledge and students. This does not mean that he must restrict children's creativity and abilities to solve problems and elaborate personal strategies to solve them but it must take into account the ability to show and hide knowledge, in an interplay, according to each child and each situation.

IMPLEMENTING A DIDACTICAL MACROSITUATION TO INITIATE CHILDREN INTO STATISTICAL INFORMATION PROCESSING AND DECISION MAKING.

FIRST DAY: "In the neighbourhood of our kindergarten, you have seen many old houses and others which have been repaired. We call them recycled houses. The Town Mayor is interested in having that information and he has asked us to make a report stating the number of old, recycled and modern houses in our neighbourhood".

Methodological Strategies: Each child is given a flashcard with a number suggesting who his/her partners in the team are. Then, each team is provided with a plan of the section and register notebook. The first problem situation they must solve consists of locating the house they are observing in the plan and later they have to decide which colour should be used to represent the house in the plan taking into account the following code: red (modern houses), yellow (old hoses), green (recycled house). In this way children are being introduced to the collection of information and, to the coding and decoding of information as a means to simplify and optimise such processes. Once students have finished their tour they come back to class and share the information to reach to this appreciation: which group of house belongs to the largest group. This is just an appreciation so it is necessary to prove it the following day by doing the some tour again and registering it.

SECOND DAY: "The teacher asks children (gathered into the same teams) to note down the number of modern, recycled and old houses. Have all the teams counted the same amount?"

Methodological Strategies: Each group reads the information from the plans. Then they write the amount of houses in the plan using the procedure they have decided. The fact of writing an amount arises in the children the necessity of registering such amounts. This type of register (classification of Martin Hughes) picture-graphical, iconic or symbolic, depends on the evolution level to register amounts in which the child is placed. Besides writing amounts, children need to create a representation of the type of house corresponding to each amount and here they start organizing and evaluating different ways of organizing the information they have, as well as, the

lack of organization in some cases. The whole class shares the information and agrees on the total amount of old, recycled and modern houses. If it is necessary, students come back to their plans and count the houses in a collective way, so if one of the plans is badly made, students are taken to a new tour around the neighbourhood to check the information again. Finally they make a poster with the amount of old, recycled and modern houses.

The responsibility of doing the task, such as telling the information to the Mayor, involves children in the learning process and it is not a command. The fact of "communicating" specific information in order to be understood makes children find ways of "writing and organizing such information"

THIRD DAY: The Town Mayor sent material to write a report to inform him about the research results.

Methodological Strategies: Students work in teams, they are given a set of stripes of paper of the same size but of different colours (red, yellow and green) and a sheet of paper with a straight line so as to show people which group of houses belong to the largest group. They work in groups but solve the problem individually with support of the register. When they have to place the stripes on the sheet of paper, some children want to do it horizontally and others vertically. Most of them cut the stripes following the relationship of order of observation among the amount of houses, that is to say, they establish a correct correspondence between the length of the stripe and the cardinal number. Children show an intuitive knowledge of direct proportionality. They are asked to comment how they did their task. In the synthesis, the teacher shows them their graphics pointing out the following aspect: What do we do to decide the size of the stripes? How do we place the stripes? How can a person realize the amount of old, recycled and modern houses in a neighbourhood if they do not know the number? This reflection constitutes the intuitive basis as regards to the use of bar graphs as the best tool to show the distribution of data.

FOURTH, FIFTH AND SIXTH DAY: Children take the reports with their conclusions to the Mayor. During their way to Town Hall they observe that there are many shops around the square; particularly, they have found out that there are ice-cream shops in the same block. They also have realized that there are very few family houses but several public institutions: Town Hall, church, police station. As all this has interested them very much, the teacher takes advantage of the situation and introduces the next Problem Situation: "Have you noticed that there are many houses, shops and public institutions in the area around the square? What do we have to do in order to find out if there are more shops than houses?

Methodological Strategies: As during the first tour around the square they have made any registration they will have to do the same tour taking notes of all the necessary information to answer the teacher's questions. They are shown a plan which corresponds to the streets surrounding the square. Instructions for the codes are stated at the bottom: shops (green), houses (red), public institutions (blue). As each team has a plan, children have to discuss about the colour to use to colour the map. When all the teams have finished collecting the information (in a coded way) they come back to the classroom and the teacher asks them if there are more institutions, houses or shops? This is the first approximation to the answer of the amount of houses, shops and institutions. Children without counting will give an approximate answer. To prove that hypothesis children are introduced the following situation:

DIDACTIC VARIATION 1**:** each team is given an envelope with the same amount of red, blue and green counters and a big sheet of paper. The teacher asks them to show, if it is possible with the material, the amount of houses, shops and institutions.

Methodological Strategies: First, children set up the relationship between counters and colours used to represent houses, institutions and shops. Once they have found out that the same colours are used for the codification of the plan, they decide to place in lines or columns, according to what seems clearer for them, as many blue counters as public institutions they have counted, as many red counters as family houses they have counted and as many green counted as shops they have counted. In this way children make a "pictogram" in which the amount of houses, shops and public institutions will be read clearly, as well as they will see which group is the largest.

SEVENTH DAY: Problem Situation: One of the ice-cream shops around the square has decided to manufacture handmade ice cream and it is carrying out a survey to know which flavours are the favourite ones. They left a form with options of ice-cream flavours.

Methodological Strategies: Children are given a survey to be filled out at home. The following day they are asked how to find out about the favourite ice-cream flavour. After a classroom discussion the teacher counts opinions and asks them: "How can we do the counting?" Children suggest to draw the ice-cream flavour (or colour with the colour corresponding to that ice-cream flavour) and then each child writes the ice-cream flavour he prefers. This activity is carried out through an iconic register.

Notice that children have to organize the information in a simple chart in which the options of ice-cream flavours can be placed in lines or columns. Once they have finished the collection of data they start counting each ice-cream flavour and with the support of a numerical stripe, the number of children who have chosen that ice-cream flavour is written down. Then, they think about the favourite ice-cream flavour. In this way they find out the needed information, but the problem now is how to tell the ice-cream shop owner the conclusion, and as all the information is on the blackboard, they will have to write it down on a piece of paper. This gives sense to teacher's instruction: they have to write the information on their papers. The teacher gives them a blank sheet of paper and colours and asks them to look at the blackboard and write down the information displayed there.

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