# Researches from an Ethnomathematics Perspective

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## 1. INTRODUCTION

We will talk about some current researches in the field of Didactics of Mathematics from an Ethnomathematical perspective. Ethnomathematics (U. D'Ambrosio 1985) is a epistemological relativist position for the research in Mathematics Education. We will present: researches directed by Dr. M. L. Oliveras

a) Mathematical talented students, psychological, pedagogical, and social aspects, in a special educational program in Chile. Cultural implications in the creative Mathematical thought by talented students.

b) Theoretical study of Mathematics: Fuzzy characterization (Zadeh, Jones) of the Mathematical thought as a cultural product of the metaphorical system of human conceptualization. Epistemological validation of the different Ethnomathematics: different professional groups, Mathematics in different cultures, scholar Mat-life Mathematics.

c) Multicultural studies regarding immigrant students, in Italy, Portugal and Spain: educational conditions, linguistic limitations, teachers' attitude and the material elements for the development of the Mathematical curriculum.

Researchers: T. Vergani (Portugal); F. Favilli (Italy); M. L. Oliveras (Spain).

## 2. MATHEMATICS TALENTED STUDENTS. A parallel program with the Chilean educational system. Benavides, Maryorie - Oliveras, M. L. (University of Granada).

The research "Talented students: a parallel program with the Chilean educational system" appeared thanks to a suggestion made by Dr. M. L. Oliveras, when she visited lessons belonging to the PUC (Pontificia Universidad Católica de Chile).Talented Students Program in July 1997. The main objectives of the Program are: to help to detect and create people with a Mathematical talent and improve the cultural development of children with few resources.

The criterion that defines a talented person depends on the cultural background, as the outstanding performance is the product of a group valorization, which has validity inside the group where this judgment is done. The Real Academia Española Dictionary (1990) defines "talent": 'intellectual skills, such as creativeness, capacity, prudence, etc., that shine in one person'.

Normally, those problems related to the kids with learning difficulties are the object of most studies. But, why not be concerned with those pupils with Mathematics innate potentialities? In this research, "Talented students: a parallel program with the Chilean educational system", the effectiveness of the program will be studied when trying to stimulate the innate abilities of children aged nine to ten.

The Mathematics talented students program detects children with ages between nine and ten with cognitive abilities in Maths, and it offers them a special Mathematical formation for the rest of their primary and secondary education. The objectives of this program are:

1) To help to detect and create persons with a Mathematical talent, so that they may eventually go further with Mathematical researches or any other activities that require a superior Mathematical knowledge.

2) To improve the cultural development of those kids with few resources.

This program has been carried out by Mathematics professors and scholars from the PUC, student assistants from the same University, and school teachers from La Florida county.

The selection process was done with a "Selection Test", elaborated by a group of researchers from the PUC in 1993; this tool is formed by 23 multiple choice questions, and it is intended for detecting innate capacities of: Geometrical perception in plane and space, the capacity to relate and understand the enunciation. This test was given to around five thousand students from La Florida county, and all those kids with marks equal or superior to 14 points were selected (each correct question gets a point). Thus, 32 students were selected, 16 girls and 16 boys.

The lessons took place on Saturdays, from 10:00 to 13:00, outside the traditional normal school timetable, in a room of the Pontificia Católica Universidad of Chile.

In this program, the didactic transposition process, the selection of the Mathematical knowledge to be taught was done by Mathematics scholars. Regarding the didactic contract, the students know that the educational system is different from the traditional one, the learning is not qualified, only evaluated.

The contents studied in the program are: Geometry, Algebra, and Combinatorics, taught using the ideas developed by Bruner, regarding the spiral curriculum and the learning process through discovering, that is, insisting on the basic structure of the new material, offering a lot of examples of the concept being taught, helping the pupil to build codification systems, applying the new content to several situations, showing the students a problem, and letting them find the answer, stimulating them to make their intuitive suppositions.

Therefore, each semester one works with a Mathematical content through the workshop methodology, with especially designed guides for these kids, starting with areas, and then, chronologically, with wholes, fractions, decimal representation, Geometry, equations, secret codes, and Combinatorics.

The research "Mathematics talented students: a parallel program with the Chilean educational system" was accomplished with a quantitative and qualitative methodology.

The hypothesis of the quantitative research is: 'The program of Mathematical talented students, carried out in the Pontificia Universidad Católica of Chile, for primary and secondary pupils, enhances the abilities of talented children'.

In the qualitative aspect, one tries to answer these questions:

1) What is the contribution of the program of talented students to the development of the innate potentialities that the children already had?,

2) How much does the program of talented students influence the work of the children in the educational system? and

3) Is there any difference between the strategies used by the children inside the talented students program and those who are not in the program?

For the quantitative study, it has been done as an "external view" of the talented students program, making a comparison between the experimental group and the control group, through the administration of the tools: the program "Selection Test" and two questionnaires. The main conclusion in this respect is that those children of the program have a greater ability to explain in a written manner the solution to a Mathematical problem, which could be due to the fact that they have more familiarity with the Mathematical activity, when thinking about the solutions to the problems.

Regarding the qualitative study, an "internal view" to the experimental group was used, with the following tools: the program "Selection Test", two questionnaires, and the observation of the lessons. It has been possible to prove that the contribution of the program to the children that participate in it refers to the fact that from basic Mathematical concepts they are able to develop a more complex Mathematical knowledge, an abstraction that children can learn, apart from expanding a wider

discernment and a critical mind. Moreover, thanks to the workshop methodology that children have in this program, they are able to express part of their reasoning process when answering problems that they have developed through the discussion of the answers and the group work that they carry out.

The projections of the quantitative-qualitative study done by the talented students program are based on opening a new research field in this kind of experiences about the teaching and learning process of talented kids, a not very explored issue. The themes we intend to expand with the study already done are:

1) Investigation of materials (teaching-learning guides), the teachers, the semester evaluations, the Mathematical contents, and the psychological aspects of the pupils.
2) The creation of teaching-learning models for kids with a Mathematical talent.
3) The inclusion in the teachers formation curriculum of the theme: 'Children with especial Mathematical abilities'.
4) An ethnographic study.

This last item is being studied at this moment, and the ethnographic research objective of the Chilean talented students program is to discover the culture of that particular community, to establish a global comprehension of all the elements that participate: students, teachers, materials, and Mathematical contents. This study is done by means of participant observation, with the following steps: field demarcation, preparation of the documentation, investigation, and conclusions.

**3. DIFFUSE MODELLING OF THE MATHEMATICAL THOUGHT**

I consider that the Mathematical thought is part of the global way of thinking of the people. That is why one can consider Mathematics as integrated inside the metaphorical system which gives shape to the meanings that form the knowledge of each person, integrated inside a global cultural system.

In 1994, we initiated a theoretical study which attempts to give shape to these ideas through the 'Diffuse modelling of Mathematics', based on the theories by Zadeh and Jones. An article has been published recently in the periodical ***ZDM*** (*Zentralblatt für Didaktik der Mathematik*), in its number 99/3 ISSN 0044-4103, of June 1999, in which I have talked about ETHNOMATHEMATICS and the diffuse modelling of the capacities of the Mathematics teacher. The ethnomathematical aspects remain validated if the diffuse Mathematics are accepted as a formal Mathematical theory about the existential reality, in which nothing is clearly true or false, but there exist degrees of certainty.

Currently, I am working on this project, and I will present new data in the ICEM-9, in Tokyo, August 2000.

Regarding Ethnomathematics, one can consult the CD-Rom with the records of the ICEM-1 (First International Congress on Ethnomathematics), held in Granada (Spain) in September 1998, in which our ideas about the post-modern mathematical thought, also called "ethnomathematical", are compiled, apart from the contributions of around one hundred attendants to the Congress. In this meeting, it is possible to see how the Mathematical and the teachers of Maths community has evolved in their beliefs about what Mathematics and its language are.

**4. IMMIGRANT STUDENTS, A MULTICULTURAL STUDY**

KEY WORDS: Immigrant students. Formation of intercultural mediators. Creation of videographic materials.

**SUMMARY OF THE PROJECT:**

The idea is to elaborate and experiment didactic material with multimedia technology, for the teaching of Mathematics in compulsory education classes with immigrant students. These materials will

have the methodological focus based on Multicultural Mathematics and Ethnomathematics as an epistemological viewpoint. This viewpoint is motivating, and it enables the Mathematical learning in children with especial difficulties, due to the fact of being immigrants, and because of their language, and different cultural conceptions.

The design and development of a training course for teachers will be also done, which will comprehend their actualization and training for the role of intercultural mediators, and the subsequent application to the field of Mathematics.

**SCIENTIFIC OBJECTIVES:**

In this sense, this project tries to be: a) A pioneer curricular research for the education of the European Multicultural Mathematics, with the foundations of Ethnomathematics, which has been looked into by the participants, in their acclaimed works. b) A work with the Mathematics teachers, through a couple of questionnaires, with which we will try to compile their needs for a specific didactic proposal. c) To experiment with the elaborated didactic material. d) After those steps, to re-elaborate the material for the teaching of Mathematics in a multicultural situation, according to the results obtained.

**METHODOLOGY AND WORK PLANNING:**

The methodology we use will be: During the first year,

- Ethnographic observation and investigation, together with interviews structured through a questionnaire, to obtain the information about the social and school situation of the immigrants, with its implications in the learning of Mathematics.

**HEADMASTER QUESTIONNAIRE**

1. Do you observe more integration problems in your immigrant students than in the rest of the group?
2. Do these students know how to speak Spanish properly?
3. Do they attend their lessons regularly?
4. Are their parents concerned with the education of their children?
5. Do their parents participate with the school administration?
6. Did you give any sort of training to the teachers in charge of these pupils, like meetings and conversations with the school counselor?
7. Did you get any kind of complaint from the parents of the rest of the students because of the presence of immigrant students?
8. Which social level do these parents belong to?
9. Do you have any special support for the teachers regarding curricular and didactic materials to be used with these immigrant students?
10. Do teachers have any special training to work with immigrant children in their classes?
11. Do teachers with immigrant students have any kind of special meetings?
12. Are they in touch with other schools with immigrant students?

Also, there exists another questionnaire to find out the faculty formative needs.

**TEACHER QUESTIONNAIRE**

1. Have you observed if these kids have had serious integration problems? In which sense?
2. Have these students been welcomed by the rest of their class mates?
3. Do they speak Spanish properly?

4. Do they attend classes normally?
5. Do they participate in out-of-school activities?
6. Which subject do these kids find more difficult? Why?
7. Do you think that these immigrant students deserve any special support in a particular subject?
8. Do you observe great gaps between the knowledge level of your immigrant students and the rest of the class?
9. What sort of attentions does your school system usually give to solve the problems of the immigrant students (socialization, knowledge...)?
10. Do parents play an active role in their children's education?
11. Do parents of immigrant children ask you for appointments for private meetings-tutorials, or do you have to call them?
12. Did you do anything special to introduce the immigrant students to the rest of the class?
13. Did you get any kind of training about how to act with immigrant students from the school counselor?
14. Are these children more conflicting than the rest of their class mates?
15. Do they present special difficulties with the subject of Mathematics, or the usual ones, like the rest of the group?
16. Do they do their homework?
17. Do they work in groups properly?
18. Do they work in class properly?
19. Do you know the socio-economic background of these immigrant students?
20. Do you know if both parents work?
21. Who is in charge of the education of these children, the father, the mother, the grandparents?
22. Do you know if the family is related to other immigrant families?
23. Do you know if these children have friends outside the school walls?
24. Do you know if these kids receive any kind of cultural influence from their country at home (they watch their home country T.V., they read folk tales from their country, etc.)?

- Study of the cases regarding the individuals with special educational needs[1].
- Didactic planning, for the design of the courses and the modules for the teachers training, so they can become ethnoeducational agents or intercultural mediators.

During the second year,

- Coordinated work with the teachers, to elaborate the videographic material to be used with the students.
- Elaboration of such material.
- Make use of some elements of that material in class, observation of the results.
- Research analysis of the results of these actions with the students and with the teachers.
- Proposals for the modification of these materials.
- Elaboration of the conclusions of the research.

[1] We are elaborating the information of the detected students, particularly a Saharaui girl, and several Chinese kids who live in Spain.

## 5. CONCLUSION

The nexus, or connection, between these research projects is Ethnomathematics, being understood as an epistemological relativist positioning, from which there exist several modes of Mathematical thought, several visions, as many as different cultures, and even as many as different subjects involved in a particular background limited not only by the "macro-culture", but also by the various "micro-cultures", which determine their vital systems of thought, feelings, and values.

All are accepted as valid if they give answer to vital realities in which some group objectives are achieved, to which the Mathematical thought contributes, as part of the global system of the human thought.

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