MICROPROJETS FOR INTERCULTURAL EDUCATION

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Introduction

Europe is a conglomerate of cultures, blended over a long time into a continental geographical environment, within which different languages and even different alphabets, religions and traditions coexist, with several ethnic groups. These ethnic groups are happily mixed at the present time, although originally they had different origins and their frontiers are now more elastic which allows migratory exchanges with many other cultures from all over the world. Europe is really multicultural now.

Europe, as a multicultural social group, needs educational models to promote a way of thinking and actions that will make its citizens appreciate and positively value this diversity and so prevent the xenophobia that led to the great wars and ethnic massacres in the 20th century.

The presence of pupils from several cultural groups within the same classroom is now a reality in Europe. The Education Systems in different European countries are attempting to adapt their ways of acting to that multicultural reality, since one of their main pedagogical principles is that of *looking after diversity*. Nonetheless, there are still not enough suitable *didactic resources* to perform the tasks for teaching and learning the different subjects, including Mathematics: resources that are thought up and developed with a structure and contents that are based on the ideas of cultural diversity in science and intercultural enrichment as the target for education.

Furthermore, there is not enough experience either in terms of the organization within institutions for implementing an intercultural education at Obligatory Schools and at Second Schools or Further Education establishments. The educational models used at these centers do not always promote intercultural enrichment for all the pupils and in many cases they tend to ignore the cultures that are not the dominant one. They try to make minorities blend in with the majority social fabric, without preserving their roots or encouraging their original cultures and even less so backing changes for society.

Another highly important and urgent aspect is active training for Teachers, training them so that the classrooms will be the environment in which a positive intercultural situation will be created

IDMAMIM (Innovation in Mathematical Didactics in Multicultural contexts with pupils from Minorities and Immigrants),is a project that was first set up in 1999 and which was carried out over five years (2000-2005). IDMAMIM involves three European countries: Portugal, Italy and Spain, with the approval and economic backing from the European Commission for Education of the European Union (SOCRATES/COMENIUS Program for Teacher-training and the improvement of teaching quality).

It is aimed at training mathematics teachers and includes the development of didactic resources, and which covers two phases:

*in the first phase, the difficulties and needs of teachers who work in multicultural classrooms are detected, and

*in the second phase, didactic proposals are provided for intercultural education, based on Ethnomathematics and implemented with technological support.

Our theoretical viewpoint

A viewpoint on multicultural classrooms cannot be taken and neither can an intercultural education model be proposed without first defining what is understood by culture. Not explaining this concept has meant a serious barrier for the advancement of research into the phenomena of multiculturalism (García, Pulido and Montes, 1999). Furthermore, the approach to and the nature of the actions both in the social sphere and the educational sphere will depend on the definition that is made for the concept of culture, as well as the model selected for education (Nigris, 1996).

Hence, we shall say that our conception of culture includes a set of semiotic aspects (symbols, expressions, forms of communication, artistic expressions), socio-political aspects (organization of work, of social relationships and power), interpretative aspects (mythology and religion), cognitive aspects (forms of knowledge linked to the environment) and technological aspects (products or artifacts created for the purpose of dominating nature, or to make work easier, or to make leisure possible, etc…) (Oliveras, 1996).
Thus it is possible to talk about both macro-cultures (such as the cultures of origin for immigrants from a given geographical region) and micro-cultures, amongst which we may include: an age culture, a school culture, a neighborhood culture or a culture for craftsmen.

Mathematics form part of these cultures, insofar as they include symbolic systems for their expression and communication, which study any kind of relationship established by the human subject who is their agent, which form part of the natural and scientific form of learning and which in turn are tools in the technology and logical pattern in many games. It may be concluded from this conception of mathematics that mathematics and culture are inseparable (Bishop, 1988; Oliveras, 2001).

Ethnomathematics represent the set of all types of mathematics in existence. They are prototype practices that constitute a large and representative part of different cultures and micro-cultures. Formal mathematics are seen, from this position, as one of the possible types of mathematics, those practiced by the "cultural group" of scientists.

Starting off from this scenario, we agree with D'Ambrosio that ethnomathematics are the mathematics practiced by culturally identifiable groups such as national or tribal societies, trade groups, children in a certain age range, professional classes. This concept of "ethno" includes all groups with their own jargon, codes, symbols, myths and their specific reasoning and inference processes (D'Ambrosio, 1985)[i].

To sum up, ethnomathematics provide a conceptual framework for multiculturalism in mathematics education. They include the discussion of the historical and cultural aspects of mathematical knowledge and their application to teaching mathematics in modern-day classrooms (Ortiz-Franco, 1998),

Given the aforementioned approaches, we may assume that all classrooms are multicultural, when we understand that we are not only referring to the "great" traditional cultures, but also to the ones that we have called "micro-cultures".

Once these basic premises have been taken on board and we have become aware of the presence in our classrooms of multiple cultures, it is necessary to implement a multicultural educational model where the didactic proposal that we shall make below will fit in.

Amongst the different existing models for educational care in a multicultural classroom, (García Castaño, Pulido and Montes, 1999), there is one that is fairly widespread in Europe, called: *the Assimilationist model*, which attempts to make educational opportunities equal for pupils from different cultures and so increase the academic success rates for these pupils. Deep down it appears to accept that one culture is superior to another, which is interpreted by us as a new form of moderate racism. We reject this model. We propose others, such as the one called *Cultural pluralism*, which endeavors to preserve and spread pluralism, whilst valuing the differences given the wealth that they provide for social welfare, or the so-called *Education as Social Reconstruction* or *Anti-racist Education.*
Education as Social Reconstruction, which proposes that education is a fight for social change, for the control of resources, wealth and prestige. It encourages the interaction between groups to achieve knowledge (socio-constructivism).
Anti-racist Education, which aims to do away with institutional discrimination, by discovering the way in which differences are used to harbor inequality.
We understand that multicultural education does exist, to a greater or lesser extent, depending on the educational model selected, in all those situations in which there is an awareness of the presence of several cultures in a classroom or an educational center, however the concept of intercultural education involves, apart from that process of becoming aware, a dynamic feature, which includes a number of objectives and specific actions for interaction between the cultures and "for affirming culture itself in its relationship with the others", which

will make it possible to introduce the equality of training rights and opportunities for all.

Our wide-ranging concept of culture does not allow for any other way of understanding multicultural education than through intercultural education, which includes the valuation of cultural pluralism, maintaining your own cultural identity and appreciation of the mixing of cultures as general enrichment. This positive viewpoint, when shared by teachers, should be the tool for overcoming the difficulties and dangers (Vithal and Skovmose, 1998) that arise from a simplistic or folkloric use of indigenous mathematic knowledge in the classroom.

Intercultural education, from our viewpoint, includes actions aimed at all the pupils and not just at those from minority cultural environments and it has its framework or base in the same conceptual philosophy as ethnomathematics. Awareness of the presence of different cultures and acknowledgement of the particular ways in which each one can develop mathematics is one of the notions behind ethnomathematics.

Intercultural education in the IDMAMIM project

One of the main targets of the IDMAMIM project is that of highlighting Mathematics teachers' needs in multicultural school contexts, when faced with the presence of pupils who are immigrants or from ethnic minorities. The aim is to implement a truly intercultural form of education and not simply a multicultural education forced by the circumstances.
The project focuses on training teachers about the concepts of intercultural reality and ethnomathematics. To do so, it is intended to develop an innovative conceptual approach to mathematics in which the pupils' different cultures and linguistic will be taken into account and included in the teaching of this subject (Shirley, 1998).

With this aim in mind, research started into the characteristics of intercultural education and the importance of two elements in the latter:

> a-The teachers' conceptions about education, mathematics and multicultural reality and their opinion about immigrant pupils in the classroom,
>
> b-The availability of suitable didactic resources for the development of mathematics teaching and learning, from an intercultural viewpoint.

To do so, a theoretical and empirical study of a cyclic nature has been performed. In the latter, following an initial theoretical review, we went on to carry out an empirical study on the teachers' opinions and continued with a more in-depth examination of the framework and the analysis of the data obtained from the theoretical models selected.

Finally, active training actions were carried out by means of the production and diffusion of specially developed resources, as well as by means of the

interactions between the teachers and the researchers during Seminars held in each one of the countries involved and subsequently between countries.

The work was carried out with teachers, some of whose pupils belong to ethnic minorities and most of whom are aged between 12 and 14, who are the indirect beneficiaries of the project.

The data have been obtained using a survey and an interview relating to:

- the knowledge held by the teacher about the characteristics of the immigrant pupils in the class, with regards to their general and mathematical learning,
- the awareness about the teacher's special role in these classrooms and professional attitudes when faced with this situation.

The activities already carried out are the following:

- Preparation in each country, three party debate and final text agreed for wide-ranging questionnaires aimed at the teachers; Distribution and analysis of the data corresponding to each country and a synthesis of all three.
- Interviews with teachers in their classrooms and analysis of the answers; the analyses are of a qualitative nature and their synthesis shall be drawn up.

The questionnaires were drawn up regarding the teachers' attitudes when faced with the presence of pupils from minority ethnic cultures in the mathematics class. These questionnaires were given to about two hundred Primary and Secondary School teachers in Spain (Almeria and Granada)[ii], Italy (Pisa) and Portugal (Lisbon).

The questionnaires were divided into three sections: the first one, in which each pupil's specific situation is described (age, origin, mother tongue…); the second one, in which the teachers could express the difficulties that they had encountered with their immigrant pupils (for integration in the class, understanding the language, specific difficulties in the subject of mathematics…); and the third one, in which the teacher answered questions relating to his/her attitude, opinion, training, etc.. about working as a teacher in classes with these kinds of pupils.

The analysis of the answers provided a basic statistical description.

During the first term in this school year of 2001-2002, personal interviews have been carried out in a semi-structured way, for an in-depth analysis of teachers' specific cases.

The general aim is, as has already been mentioned, to highlight the teacher's conceptions that arise in the area of mathematics and drawn up sometimes in terms of the needs in multicultural school contexts when faced with the presence of immigrant pupils or those from ethnic minorities. To do so, other subsidiary targets were proposed, i.e.:

1. Detect the teacher's opinion about the presence of immigrant pupils or those from ethnic minorities in the classroom, how they see their performance, whether they notice difficulties in adaptation and learning.
2. Specify these pupils' difficulties regarding Mathematics.
3. Determine the teacher's role in a multicultural type situation.
4. Express secondary teachers' needs for the proper treatment in the classrooms for pupils from other cultures; needs of a material nature, training, institutional care, personal needs or those which are the responsibility of the administration.

Using a friendly dialogue based on a script drawn up in advance by the researchers, the interviews have covered subjects such as the difficulties and attitudes of immigrant pupils in different areas, the presence of mathematical knowledge different to the "usual" knowledge, the attitude and tasks performed by the teacher in order to deal with the multicultural reality that was faced and the wishes to collaborate with the IDMAMIM project (in the sense of allowing to be informed and trained about the microprojects, setting them up in their classroom, permission to be filmed whilst working…).

Some of these interviews were recorded on tape and/or on video and they were included in the CDs that have been produced in the final phase of the project.

Conceptions detected amongst mathematics teachers

The analysis of the questionnaires and interviews carried out has highlighted the numerous difficulties that mathematics teachers encounter in order to modify any aspect of their teaching work in the multicultural classroom.

We discovered that these difficulties correspond to different factors that we explain below:

- ***Their conception about education***. The teacher understands education as the transfer of knowledge from the expert to the learner and classifies his/her pupils by their capacities. The fact that immigrant pupils demonstrate (generally in written tests) lower capacity has no cultural explanation nor does it allow for any specific action by the teacher. "It is taken for granted that this variable cannot be treated culturally. It is used as an excuse by the teacher" (García, Granados and Pulido, 1999).
- ***Their concept about culture***. On many occasions culture is understood as a set of exotic aspects, a different language or religion or the mere accumulation of knowledge. So it is suffice to refer to these aspects from time to time, teach them the official language of the country that houses the immigrant pupils or teach them in support groups for the "mathematically challenged" in order to provide them with an intercultural education. Of course this leads quite often to academic failure and frustrations for all those involved.
- ***Their concept about intercultural education***. Our study demonstrates attitudes amongst the teaching staff that are very far away from our conception of intercultural education and to which we attribute part of their difficulties. There are teachers, for example, who choose an

assimilationist viewpoint, who take insufficient measures (such as proposing isolated examples that have something to do with the country of origin) or who do nothing despite being aware about the coexistence of various cultures in their class. At the other end of the scale, there are teachers who understand that intercultural education has no place in mathematics teaching, but rather in the subjects of Social Sciences or Natural Sciences (If I were a Social Sciences teacher.., I could, but mathematics seem to be more neutral", and other expressions of this nature have been recorded in the interviews with teachers).

- ***Their conception about mathematics and ethnomathematics***. The mathematics curriculum has been slow to impose a change that reflects the multicultural nature of society "due in part to the failure to separate the universal nature of the truth of mathematics (the sum of the angles inside a triangle is 180º is true the world over) from the cultural basis of knowledge" (Gilmer, 1991). This fact, which many authors have emphasized (for example, Bishop, 1988), has expressly been stated by the teachers surveyed with expressions such as "Mathematics is "universal" and so does not depend on cultural traditions". That is to say, many mathematics teachers still accept the absolutist paradigm, which accepts the existence of a single scientific knowledge. In other cases they omit (they are not assessed when giving an opinion on a pupil's capacities) procedural and attitudinal contents inherent in mathematics which, nonetheless, pupils from cultural minorities may in fact possess (special abilities, heuristic strategies, application of mathematics, working organization and habits, concentration on tasks, tenacity in seeking solutions, flexibility in dealing with situations, acceptance and appreciation of different viewpoints, autonomy of thinking for taking decisions, taste for certainty, curiosity, creativity, interest, motivation, participation in activities…). All of which prevents them from considering the indissoluble union between mathematical knowledge and culture.
- ***The scarcity of resources*** (both material and human). Awareness, which is growing constantly, about the fact that the world is multicultural by society and the institutions, makes us rely on the fact that this need, which has often been expressed by the teachers interviewed, will be solved. In fact, the draft document for the Andalusian Plan for Caring for Immigrant Pupils includes as one of its proposals "the provision of extraordinary human and material resources for the centers which admit a significant number of immigrant pupils". Meanwhile, we may highlight the scant number of references to investigate (this lack of resources is one of the main reasons behind the IDMAMIM project) in the teachers' own answers regarding the use of suitable materials; "We just don't have anything at our school", "They are beyond my reach"; "I am not familiar with them"…). The new draft paper for School Reform in Italy places great attention on the presence of immigrant pupils and promises to improve the opportunities for the teaching staff to act.
- ***Lack of time***. A proper study of cultural diversity would be obliged to start off from relevant cultural activities and not from mathematical contents included in a program (although they may be considered as a subsidiary topic and formalized in later phases). This would greatly

reduce the already scant time available and would leave the obligatory programs unfinished.

We have been able to see for ourselves the lack of training amongst mathematics teachers regarding concepts such as multiculturalism, intercultural education or ethnomathematics… (72.5% of the teachers surveyed were unaware of mathematical activities belonging to other cultures).

However, fortunately, we have observed concern about improving this training and dealing properly with the pupils from other cultures, as demonstrated by some of the answers regarding the teacher's feelings in a multicultural class: "It is stimulating for everybody to have pupils with different cultural identities"; "You can learn a great deal from them"; "Working with these pupils is a source of inspiration".

Microprojects on Ethnomathematics.

Other activities were carried out, in all three countries, as part of the IDMAMIM project are:

- Collection and analysis of curricular documents such as: center projects, department and classroom programs.
- Cycle of seminars and meetings with teachers.
- Preparation, experimentation and validation of didactic resources (Microprojects, Oliveras, 1996).
- Transcription of these materials on a CD with didactic guides for their use in the classroom.
- Final report.
- Activities for diffusion amongst teachers.

We understand that, regardless of the strong link between mathematics and culture that we have posed in our theoretical approaches, there are universal activities that belong to mathematics and are practiced in different ways in each culture, such as counting, locating, drawing, explaining and playing (Bishop, 1998, quoted in Oliveras, 2001). D'Ambrosio defines ethnomathematics as the particular way that specific cultural groups have to face up to the tasks for classifying, ordering, counting and measuring (D'Ambrosio, 1985). These activities are the thread that joins the microprojects together.

We define the Microprojects as didactic units that aim to inculcate certain mathematical concepts, from a socio-constructivist outlook, to pupils in multicultural classrooms, starting out with relevant activities in one or several of the cultures present in the class.
This involves globalized or interdisciplinary resources, during the implementation of which contextualized mathematical meanings are created. They include some targets, amongst which the treatment of cultural diversity is explicitly reflected; some mathematical contents are extracted from these activities through prior research which we have called "Culturally relevant"; a methodology based fundamentally on learning through discovery and group

work; a sequence of activities using handicraft type activities and subsequent reflection; and some criteria and instruments for evaluation, with the latter being understood to mean the teaching sense and not one for sanctioning.

Each one of the countries involved in the IDMAMIM project implemented one of these microprojects. These microprojects shall be exchanged, experimented and subjected to a careful critical analysis in all three countries before being proposed as activities for intercultural mathematics education, which the teachers can implement and use as examples to be imitated, then creating for themselves new microprojects that will develop the curriculum.

We believe that the work with microprojects will raise the self-esteem of those pupils with learning problems and will allow a true interdisciplinary treatment of mathematical contents and will deal properly with cultural diversity therefore producing a real intercultural form of education.

Conclusions

As a result of all these tasks, the following are expected: that teachers will gain intercultural conceptions along the line of ethnomathematics and skills in their specific professional work with mathematics, thereby developing attitudes that will encourage interaction amongst their pupils who will benefit in turn from the cultural contributions from their classmates.
The creation of a common ground for resources, drawn by whilst still preserving the knowledge and pride of their different cultural roots and the promotion of greater interest in mathematics amongst all the pupils by also introducing new computer Technologies as a common value to all cultures.

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[i] Ubiratan D’Ambroiso is the founder of the ISGEM research group (International Study Group on Ethnomathematics) and a pioneer in this line of work.

[ii] It is not possible to list all the schools that have collaborated with this work, nevertheless our most sincere gratitude goes out to them all for their interesting contributions.