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Education in mathematics in a Europe of different cultures

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Education for an Interdependent World (EDIW), (Belgium)

This paper will highlight some theoretical and methodological aspects of mathematics education in multicultural contexts and in programmes for Intercultural Citizenship, part of a larger project for teacher training promoted by EDIW¹. We begin by describing the EDIW project and move on to consider the learning of mathematics in multicultural contexts within Europe and the role of affectivity in this process. We will conclude with some data from a research project with Portuguese pupils in Brussels.

EDIW: a field-work programme within the framework of teacher education

Training and education for participative citizenship is imperative in democratic societies. Education for citizenship is one of the educational priorities for the European Commission for 2000- 2006. The democratic ideal must be reinvented from the perspective of the responsible participation of every citizen in daily life.

This participation must include diversity as one of the means of building, in solidarity, the conditions for a decent life for all. The education of children and of young people for a responsible and active citizenship is a priority for the construction of a Europe where citizens are democratic and supportive of each other (Amsterdam Treaty 1997). The educational process should introduce students to democratic practices in their behaviour, in the development of welcoming attitudes, solidarity and respect for diversity. This implies schools that are open, grounded in their own environment and supported by well-trained teachers and educators.

In response to this need EDIW maintains projects and networks² directed at education for citizenship, both at school level and at the level of teacher education (EDIW, 2000). The projects carried out by EDIW aim to respond to two felt needs:

1. the coordination of programmes within formal education for the education of teachers in intercultural citizenship:
2. teacher education.

¹ EDIW - Education for an Interdependent World - is a European international association whose aim is to promote and facilitate actions and projects in the field of education which are directed at the formation of citizens in solidarity and responsibility and to work towards a greater justice in an interdependent world. EDIW is part of three of the biggest European networks within the Socrates programme (among them 'Children's Identity and Citizenship in Europe') and at present is launching and coordinating a network about European identity, 'To think and to form in the European Identity. Experiences and methodology', which has been formed as response to the conclusions of the seminar on the same theme which took place in Salamanca in October 2002.

² Thematic network: 'To think and to form in the European identity. Experiences and Methodology' (network coordinated by EDIW and made up of 22 institutions from various European countries).

In teacher education we wish to underline the role of the teachers themselves. In the most recent educational reforms in the countries of the EDIW network, a deficit has been identified in this aspect of teacher formation and in their triple roles of teacher, tutor and researcher.

Continuous education to remedy this situation has not succeeded in convincing the teaching professionals, who still consider themselves poorly prepared to take on the responsibilities inherent in this new role (INRP, 1998). It is for this reason that we should keep in mind these shortcomings when looking at the formation of teachers to enable them to develop new personal and professional capabilities.

For the school socialisation, instruction and education are three pillars on which to build a citizenship that is intercultural, dynamic, plural, global and local. It is not enough to identify education for citizenship with the socialisation role of the school. Such an identification is short-sighted: from a wider perspective active citizenship requires knowledge and the ability to understand and transform reality. It enables the individual to develop his/her own capabilities and to build a personal and social identity. It implies learning to live with others.

The learning of mathematics in multicultural classes in Europe

Mathematics is acquiring a greater prominence in society and contributes to the enhancement of culture. It is therefore necessary to conserve and transmit this legacy to new generations. This presents us with a challenge because it must be done with real individuals - with their own personal characteristics, their own affectivity, their personal learning processes, their own environment - who are immersed in contexts and cultures that share ways of thinking, feeling and acting. This invites us to consider the social aspect of mathematical knowledge and to view the students as social beings in an historical context. Therefore one of the present challenges is to create a wider framework and a holistic vision that will allowed for the adaptation of the internal relationships that govern mathematics and its teaching to cultural paradigms and contexts (Callejo & Gómez-Chacón, 2000).

A basic mathematical literacy that considers these aspects contains some challenges:

- to recognise and renew the mathematical knowledge associated with each culture;
- to establish teaching practices to include students' social contexts;
- to facilitate the contribution of mathematics to the construction of students' social identity;
- to adapt the internal relationships that govern mathematics and its teaching to certain cultural contexts and paradigms;
- to prioritise the interaction of mathematics and its teaching with the reality students are experiencing;
- to identify the extent to which learning is mediated by the values and beliefs to which knowledge is linked by the different social groups;
- to incorporate life experiences and to assess the effect of emotion and affectivity in the learning of mathematics;

- to identify the different conceptual frameworks which arise from the cultural origins of the students.

To a certain extent these challenges were kept in mind, and will be presented in a case study conducted with Portuguese students in Brussels. The project investigates the possible repercussions of their social and cultural identity in the learning of mathematics.

Identity and multiculturalism: the effect of cultural and affective factors

The case study we are carrying out in Brussels had the following objectives:

- to highlight some of the social interactions in the classroom that seem to hinder the learning of mathematics and to determine the failure rate of the students;
- to explore and describe tensions, conflicts and resistances that occur in the learning of mathematics in multicultural contexts which may be the result of the social and cultural positioning of students;
- to explore in depth and work with dynamic models that explain mathematical learning in situations of social change, where individuals and groups are exposed to forms of knowledge originating from different social and cultural groups coexisting together;
- to identify the teacher skills needed in multicultural contexts and situations of social change.

As we have said, to educate for Intercultural Citizenship is not limited to the socialisation of the student, but requires certain competencies and aptitudes in teaching. In the field of mathematics we recognise the need for a basic mathematical literacy that is mindful of the socio-contextual and emotional dimension in the learning of this discipline. In this regard we refer to other studies: at their last conference CERME had a working group on strategies for teaching, research and educational policy in multicultural contexts (CERME 3, 2003).

At the European level there have been different attempts to evaluate curricula and establish a common approach for the learning of mathematics in Europe³. Nevertheless we still have a long way to go to achieve the basic mathematical literacy that we propose. Our contribution to the programme of education for Intercultural Citizenship from the mathematics standpoint is to develop the study in the field of Emotional Mathematics (Gómez-Chacón^{2000b}).

We understand by [emotional literacy] (Gómez-Chacón^{2000a}) an educational process which is continuous and permanent, and that aims to facilitate emotional and cognitive

³ 'Reference levels in school Education in Mathematics in Europe at 16'. A project of the European Commission conducted by the European Mathematical Society (EMS) with the help of the Institute of Research in Mathematics education of the University of Franche – Comté (IREM of Besançon) – France and of the French Association of Teachers in Mathematics (APMEP), 1999
http://www-irem.univ-fcomte.fr/Presentation_ref_levels.HTM

development as part of the holistic development of the person. To this end we propose the development of knowledge and skills about the affects (emotions, attitudes and beliefs) that will enable the individual to better meet the challenges of daily life. In this study we consider three basic elements - beliefs, attitudes and emotions - estimating the expressions of affectivity by students at two levels: local and global.

We consider it important to deal with the beliefs of students aroused by the social and cultural context and to examine the repercussions such beliefs have in students' learning processes. This will demonstrate how values and beliefs about and in the social and cultural context influence the selection of knowledge and the circumstances and conditions in which learning takes place. Normally the teacher tries to find reasons why students fail to learn mathematics: we consider that it is appropriate to continue to study not only the cognitive demands for learning, but also and particularly the affective demands.

Methodology, tools and results of the study

As the study is taking place in Brussels, attention was paid to















- the Belgian system of education and in particular that of the Francophone community;
- Portuguese students in Brussels (where they are located, schools they went to, etc;)
- collection by means of questionnaires and interviews of personal and family data and other aspects that relate to their experience and learning situation as a *1displaced1* group (the term used inside the European Union instead of immigrant/emigrant), their experience in Belgian schools, the involvement of their parents in the schools, the fluency and use of language, Portuguese/French, their identity and their expectations for the future (Abreu, Silva, & Lambert, (2001);
- contact with their schools and mathematics teachers;
- participate if possible in some of their mathematics classes;
- collection of data about their affective life, attitudes, beliefs and emotions in relation to mathematics (Gómez-Chacón, 2000a, pp. 23-29).

In designing the investigation the techniques of ethnography were combined with those of the case studies, in addition to a reflection on the action itself. The tools used were:

- questionnaires to students, teachers and parents;
- graphs of emotions and *mood maps* (see Figure 1) (Gómez-Chacón, 2000b, pp. 95-102, 110-119);
- taped interviews with students;
- case analysis and discussion with students.

Figure 1 Mood map

The mood map is an iconic instrument which, in imitation of weather maps, establishes a code for expressing the different emotional reactions experienced by students in the course of mathematical activity.

Problems mood map			
Note that on the upper part of the page for each activity you will find a box with some symbols. Mark those that express how you felt when solving the problem, indicating at which point you were.			
Curiosity		Confused	
Cheerful		Brain teaser	
Despair		Liking	
Calm		Indifference	
Hurry		Amusement	
Boredom		Confidence	
Just great		Blocked	

Adaptated from Gómez-Chacón (2002b) pp. 95-97

All the tools used with the students and their parents were presented in Portuguese. The questionnaires to the teachers were in French. The study was done with a population traditionally classified as immigrants: children of staff members of European institutions were not included in the study. The students were in the 10th and 11th class levels.

Between February and June 2003 we collected the data and maintained contact with the students (approximately 40) in different ways:

- in Portuguese classes complementary to the curriculum. (three-quarters of an hour out of a total of two and a half hours of classes);
- in schools where there is a Portuguese population but not an intercultural focus (in mathematics classes and in a weekly meeting with Portuguese pupils only);
- in schools where there are intercultural experiences in the area of mathematics.

As the phase of data collection has not concluded, we cannot present definitive conclusions. Our preliminary conclusions are based on the field work and on a global analysis of the tools used. Some elements are noteworthy (these are not presented in order of priority):

- there was a strong option for Portuguese identity from among the alternatives given in the questionnaire, which included 1European1;
- the group under study considered that the language of the adopted country is not an obstacle to communication or learning (the majority were born in Portugal and moved to Brussels between the ages of 0 and 6 years);
- the students consider that they understand and express themselves equally well in French and Portuguese (interestingly we have established in our work and conversations with them that their Portuguese, both written and oral, is poor);

- generally there was a positive appraisal of their multicultural experiences, although some students were strongly prejudiced in relation to Turks and Moroccans, and some answers indicated that students felt looked down on for being Portuguese;
- the majority of the students did not talk at home about their school life;
- they considered the lack of precision (concreteness) in mathematics a difficulty for learning.

Some final reflections

As a final reflection we want to return to the challenge presented at the beginning of this paper: teacher formation, in this case⁴ as part of continuous formation rather than the accomplishment of short courses. We opted for a sabbatical year to undertake a personal professional project to improve formation, that although envisaged in Portuguese legislation⁵ is not extensively used or easy to access.

From the work done so far we conclude what is most valued for personal development is the possibility of reflecting not only theoretically (this allows naming and systematising intuitions and finding ways to tackle problems encountered in practice and for which there no solutions in the manuals) but also in the daily surprises - how we react to the unknown, to the difficulties, to the cul-de-sacs we meet. Another important factor is that this work is carried out outside Portugal, where respondents have had personal experience of the advantages and disadvantages of multicultural living. In the field of education for Intercultural Citizenship there is a long way to go, and changes must be made consciously. There are many variables to keep in mind: we point out here only the effort of reflection and the will to follow good practice. This last dimension was amply discussed in the seminar about European identity organised by EDIW which took place in Salamanca last October (Gómez-Chacón, 2003).

Some suggestions for further consideration in the area of mathematics, bearing in mind the data obtained from the research carried out, are:

- that cultural and social processes are an integral part of mathematics activity and contribute in shaping the affects of the students;
- that mathematics activity could contribute in a new way to build students' identity;
- that mathematics is a valid space for the transmission of cultural, cognitive and affective standards;
- that it is important to detect the epistemological obstacles in teaching practices;
- that instruction in the sociology and psychology of mathematics education is at present a challenging call in teacher education.

⁴ Lurdes Figueiral, BSc in Mathematics, Educational field, 15 years practice as a mathematics teacher in Escola Secundaria Artística de Soares dos Reis, Porto (Portugal)

⁵ Despacho Normativo nº 31/98 de 17 de Abril, Diário da República

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