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Mastering Mathematics, Mainstream and Minority Languages

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Abstract: The multicultural nature of modern society constitutes one of the most significant changes to have influenced schools in many European countries, especially at primary and middle school level. The teacher is seldom aware of the need to rethink and if necessary modify his/her methodological and pedagogical approach. This attitude is even more evident in maths teachers who often consider their subject universal and culture-free.

Little has been done in Europe as far as maths teaching in multicultural contexts is concerned. The different languages and cultures present in the classroom make the teaching/learning process even more arduous than it already is, especially for pupils from minority cultures and/or with a migrant background or for Roma pupils.

A teaching unit, designed in a European Commission funded project, is described. Its aim is to provide teachers with a tool to help their pupils to overcome the learning obstacle represented by the contrast between the simplicity of classroom language and the complexity of mathematics language. Teachers have to bear in mind, however, that the language used in class is an element of further complexity for pupils from minority cultures with a different mother tongue.

Résumé: La nature multiculturelle de la société moderne constitue l'un des changements les plus importants à avoir influencé les écoles dans de nombreux pays européens, notamment au niveau de l'école primaire et du collège. L'enseignant est rarement conscients de la nécessité de repenser et si nécessaire modifier sa/son approche méthodologique et pédagogique. Cette attitude est encore plus évident dans professeurs de mathématiques qui considèrent souvent leur sujet universel et sans culture.

Peu a été fait en Europe dans la mesure où l'enseignement des mathématiques dans des contextes multiculturels est concerné. Les différentes langues et cultures présentes dans la salle de classe font le processus d'enseignement/apprentissage encore plus ardue qu'elle ne l'est déjà, en particulier pour les élèves issus de minorités culturelles et/ou issus de l'immigration ou pour les élèves roms.

Une unité d'enseignement, conçu dans un projet financé par la Commission européenne, est décrite. Son objectif est de fournir aux enseignants un outil pour aider leurs élèves à surmonter l'obstacle de l'apprentissage représenté par le contraste entre la simplicité de la langue en classe et la complexité du langage des mathématiques. Les enseignants doivent garder à l'esprit, cependant, que le langage utilisé en classe est un élément de complexité supplémentaire pour les élèves issus de minorités culturelles ayant une langue maternelle différente.

Rationale

Mathematics teachers feel the necessity for training and materials which reflect the needs of their classes in terms of linguistic and cultural differences. Their pupils from minority cultures and/or those with a migrant background encounter even more difficulties than their native classmates in acquiring fundamental mathematics skills.

The above mentioned needs have been identified in several research studies carried out as to multicultural and inclusive education ([1], [4]), the role of the foreign language in mathematics learning ([2], [5], [7]) and the educational approach and methodologies for mathematics education in multicultural classrooms ([3], [6]).

The *M³EaL project* · aims to identify teaching strategies for teachers and activities for pupils who allow both to approach the challenges and facing them satisfactorily. The methodological tools used, to be considered innovative compared with the standard routine of the mathematics classroom, are the following:

- Great attention to the language used in order to provide suitable compromise between the simplicity of classroom language and the complexity of mathematics language, bearing in mind, however, that the language used in class is an element of further complexity for pupils from minority cultures with a different mother tongue;
- Proposals for didactic units for the mathematics classroom which facilitate interdisciplinary extensions and which are inspired, above all, by practical problems and situations from everyday life and from different cultures.

These methodological tools should, in general, help to make all pupils more interested and motivated to learn mathematics; in particular, enable pupils with different cultures and languages to overcome some of the difficulties they encounter in maths due to these very differences: the teaching of mathematics by using aids to activate different thought processes and skills which otherwise risk remaining latent because of language shortcomings.

Moreover, the above-mentioned methodological tools facilitate the appreciation of the positive aspects of different cultures and create favourable conditions for intercultural dialogue in the classroom, thus creating an inclusive educational setting.

A further innovative aspect is the contribution from language specialists to the communication and intercultural issues of the teacher training activities.

A teaching unit from M³EaL project

The teaching unit aims to provide teachers with a tool to help their pupils to overcome the learning obstacle represented by the contrast between the simplicity of classroom language and the complexity of mathematics language, bearing in mind, however, that the language used in class is an element of further complexity for pupils from minority cultures with a different mother tongue.

The teaching unit has been designed by the *M³EaL project* coordinator Institution, Centro interdipartimentale per l'Aggiornamento, Formazione e Ricerca Educativa – C.A.F.R.E. of the University of Pisa (Italy), and already piloted in the project participating schools selected by CAFRE and two further project partners: Ecole Supérieure du Professorat et de l'Education – E.S.P.E. of the University of Paris-Est Créteil (France) and the University of Thessaly (Greece).

Its primary target group are mathematics teachers in primary and lower secondary schools in socio-culturally diverse areas, the secondary target group consequently consisting of students from cultural minorities and/or culturally deprived groups.

The educational aims of the teaching unit can be roughly divided into general and mathematical aims.

Among the *general aims* we can consider:

- The appreciation of the positive aspects of different cultures.

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- The creation of favourable conditions for intercultural dialogue in the classroom, and, therefore, an inclusive educational setting.
- The development of awareness and critical attitudes towards the use of language and its interpretation.
- The awareness of how important it is to use specific and unambiguous language.
- The capacity to state the reason for the choices made and used during the activity.

Among the *mathematical aims* we can consider:

- The increase of the learners' capacity to understand and to elaborate the mathematical discourse.
- The improvement of the ability of reading and understanding mathematics textbooks and word problems.
- The improved usage of mathematical language.
- The reinforcement of the knowledge of mathematical glossary.
- The development of the ability to find a proper balance between the natural language and the mathematical language.

The teaching unit should lead teachers to reflect upon a number of aspects:

- Difficulty in using mathematical language correctly: uncertainties, doubts and mistakes shown in understanding the written texts express the need to favour, in teaching, the verbalisation process, which induces students not only to make their ideas explicit but also to try and make it in a clear and correct way to make them understood.
- The need to use the linguistic instrument appropriately, its use is a fundamental step towards the construction of knowledge, although it requires a considerable time for maturation.
- The need to develop activities like this one, because they offer information about pupils' knowledge, the conceptualisation level they have reached, possible gaps, and misconceptions. This information is fundamental to be able to intervene in the classroom with appropriate and well planned teaching actions.

The teaching unit consists of five main activities. If possible, all the activities should be carried out in small groups, each of which including a minority pupil at least.

- **Analysis of a textbook** (*Reading* and *Writing*)

Pupils are asked to read a chapter of their textbook and, thereafter, to search for and make a list of words and verbs in the vehicular language that are "difficult", discuss about their meaning and translate them into the foreign languages spoken in the classroom, thus producing a *micro-dictionary*.

Pupils are then asked to search for and make a list of words and verbs that are proper of the mathematical language, compare them to the same words and verbs in the natural language, discuss about and write their possible different meaning and translate the words and verbs into the foreign languages spoken in the classroom, thus producing a *mathematics glossary* and a *mathematics dictionary*.

All groups are asked to re-write the analysed pages of the textbook in the vehicular language and minority pupils are asked to translate the most significant sentences into their own mother tongues.

- **Analysis of a "word problem" from a National standard assessment test** (*Reading* and *Writing*)

The teacher chooses a "word problem" from a National standard assessment test that is meaningful as to the language used. Pupils are then given the same tasks as in the first activity.

- **Natural language and mathematics language**

Pupils are asked to identify possible conflicts originated by different meaning of words and verbs that are common to both the natural and mathematical languages, and to write the two different meaning in their own mother tongues.

- **Writing a "word problem"**

Pupils, still working in groups, are asked to write in the vehicular language a word problem. The problems are presented to the whole class for discussion about their clarity as to the language used and the mathematical notions required. Greater attention is paid to minority students.

- **"Writing a textbook"**

Students, still working in groups, are asked to write in the vehicular language a "page of a textbook" about a mathematical topic chosen by the teacher. The "pages" are presented to the whole class for discussion about their clarity as to the language used and the mathematical notions involved. Greater attention is paid to minority students.

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